Chapter 3H. Affected Environment and Environmental Consequences - Wildlife

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SUMMARY

This chapter describes wildlife habitats and wildlife use on the DW project islands and the impacts of the DW project alternatives on wildlife. The impact analysis for the reservoir islands provides a description of wildlife values that would be associated with the various flood conditions on the reservoir islands; however, because future habitat conditions are unpredictable, no wildlife values that would compensate for project impacts are assumed to be provided on the reservoir islands. Impacts of the DW project on wildlife are associated with the conversion of existing habitats (primarily agricultural) to reservoir uses on the reservoir islands or to habitat types managed specifically to provide high wildlife habitat values on the habitat islands.

Under Alternatives 1 and 2, the habitat islands (Bouldin Island and Holland Tract) would be managed primarily to offset wildlife impacts resulting from operation of the reservoir islands. Implementation of the HMP developed for the habitat islands would result in creation of seasonal managed wetlands, emergent marshes, seasonal ponds, lakes, herbaceous uplands, riparian woodland and scrub habitats, pastures, and corn and wheat fields that would be managed specifically to provide high wildlife habitat values. In addition to offsetting project impacts on wildlife, implementation of the HMP is expected to benefit many special-status and other wildlife species that currently are not found or are found only irregularly on the DW project islands.

Implementation of Alternative 1 or 2 would result in changes to wildlife habitats on the DW project islands and therefore changes in the use of those islands by wildlife species. In general, flooding the reservoir islands would result in a loss of habitat and implementing the HMP would result in a gain in habitat.

Implementing Alternative 1 or 2 could result in increased incidence of waterfowl disease, which is considered a significant impact on wildlife. Implementing a program for monitoring waterfowl disease in cooperation with DFG would reduce this impact to a less-than-significant level. Significant temporary impacts on state-listed species could occur during construction on the reservoir islands but would be reduced through development and implementation of a mitigation and monitoring plan to avoid these impacts. Use of the Bouldin Island airstrip on hunt days during the waterfowl season under Alternative 1 or 2 could result in disturbance to greater sandhill cranes and wintering waterfowl. This impact would be reduced to a less-than-significant level through implementation of a monitoring program to assess the effects of hunt-day flights on use of Bouldin Island by these species and implementation of actions to reduce any effects identified through monitoring.

Implementation of Alternative 1 or 2 would also result in less-than-significant losses of upland habitats, foraging habitats for wintering waterfowl, upland game species habitats, foraging habitat for Aleutian Canada goose, and wintering habitat for tricolored blackbird, and less-than-significant cumulative losses of riparian and herbaceous habitats. Other less-than-significant impacts would be the potential for disruption of waterfowl use and of greater sandhill crane use of the habitat islands as a result of increased hunting, increases in waterfowl harvest mortality, potential changes in local and regional waterfowl use patterns, and potential effects on wildlife and wildlife habitats resulting from Delta outflow changes. Implementing the HMP would result in beneficial increases in wetland habitats for nongame water and wading birds, waterfowl breeding habitats, foraging and roosting habitat for greater sandhill crane, foraging and nesting habitat for Swainson's hawk, nesting habitat for northern harrier and tricolored blackbird, and suitable habitats for special-status wildlife species, as well as contribute to cumulative increases in wintering waterfowl habitat in the Delta region.

Alternative 3 does not include implementing the HMP, so impacts of reservoir island operations under this alternative on some wildlife habitats would not be offset by created habitats and are considered significant. Significant impacts would be losses of upland habitats, foraging habitats for wintering waterfowl, habitats for upland game species, foraging habitats for greater sandhill crane and Swainson's hawk, and nesting habitat for northern harrier. To offset these impacts, an offsite wildlife habitat mitigation plan is recommended for Alternative 3. Implementation of Alternative 3 would result in the following less-than-significant impacts, as under Alternative 1 or 2: losses of foraging habitat for Aleutian Canada goose and nesting habitat for tricolored blackbird, potential for disruption of waterfowl use as a result of increased hunting, increases in waterfowl harvest mortality, potential changes in local and regional waterfowl use patterns, and potential effects on wildlife and wildlife habitats resulting from Delta outflow changes. Alternative 3 would also contribute to less-than-significant cumulative losses of foraging habitat for wintering waterfowl, herbaceous habitat, and wetland and riparian habitats in the Delta. Implementation of Alternative 3 would result in a beneficial increase in suitable waterfowl breeding habitat.

Implementation of the No-Project Alternative would change wildlife habitat on the DW project islands by converting fallow, herbaceous upland, riparian, and wetland habitats to crops. The effects of the No-Project Alternative would be losses of riparian and wetland habitats, northern harrier nesting habitat, and potential Swainson's hawk foraging habitat. These effects could be reduced through development and implementation of an offsite mitigation plan, but such mitigation would not be required.

INTRODUCTION

This chapter discusses impacts of the DW project on wildlife, most of which would result from habitat changes and changes in hunter use on the DW project islands. The HMP incorporated into the project description for Alternatives 1 and 2 provides for compensation habitat to be established on the habitat islands to offset the effects of reservoir island operations on wildlife species. The impact assessment for Alternatives 1 and 2 is therefore based on the assumption that project implementation would include the establishment of compensation habitat acreages as specified in the HMP. Under Alternative 3, all four DW project islands would be used as reservoirs, and the NBHA on Bouldin Island would be used to provide limited compensation habitat.

The following appendices provide more detailed information on wildlife species, their habitat needs, and the legal status of wildlife species that may be found on the DW project islands:

- Appendix H1, "Wildlife Species Nomenclature";
- Appendix H2, "Wildlife Inventory Methods and Results";
- Appendix H3, "Federal Endangered Species Act Biological Assessment: Impacts of the Delta Wetlands Project on Wildlife Species";
- Appendix H4, "California Endangered Species Act Biological Assessment: Impacts of the Delta Wetlands Project on Swainson's Hawk and Greater Sandhill Crane"; and
- Appendix H5, "Agency Correspondence regarding the Federal and California Endangered Species Acts".

For background information on existing and anticipated wildlife habitat conditions on the DW project islands, the reader is also referred to the following:

- Chapter 3G, "Vegetation and Wetlands";
- Appendix G2, "Prediction of Vegetation on the Delta Wetlands Reservoir Islands"; and
- Appendix G3, "Habitat Management Plan for the Delta Wetlands Habitat Islands".

AFFECTED ENVIRONMENT

This section describes wildlife habitat conditions on the DW project islands. Wildlife habitat information is based in part on information collected for the 1990 draft EIR/EIS and has been updated to current conditions where these changes would affect the impact analysis.

As a result of land management decisions made since 1988, some changes in agricultural land use and wildlife habitat conditions on the islands have occurred. Some of these changes were made in response to annual fluctuations in agricultural market conditions. Because some of these changes have resulted from project-related actions

and influences, information from the 1990 draft EIR/EIS (based on 1988 conditions) provides the most reliable description of typical preproject wildlife habitat conditions on the DW project islands for assessing the impacts of the DW project alternatives.

A detailed description of methods used to identify baseline conditions and results of wildlife and wildlife habitat investigations are presented in Appendix H2, "Wildlife Inventory Methods and Results", and Chapter 3G, "Vegetation and Wetlands". Habitat-type acreages are described in this chapter for the portion of Holland Tract included in Alternatives 1 and 2. Acreages of habitat types on Holland Tract that would be affected with implementation of Alternative 3 and the No-Project Alternative are described in Chapter 3G.

Sources of Information

Information on existing wildlife species occurrence and waste grain availability was collected during surveys of the DW project islands conducted in 1988 (see Appendix H2). Distribution and acreages of wildlife habitats were determined from 1987 aerial photographs of the DW project islands (see Chapter 3G).

Information on wildlife ecology, populations, distribution in the Delta, and use of Delta habitats was obtained from DFG survey data files, technical reports, scientific literature, and contacts with DFG and USFWS biologists, wildlife researchers, farmers, and other individuals knowledgeable of the Delta environment.

General Wildlife Species

General wildlife species include piscivorous (i.e., fish-eating) birds, wading birds, shorebirds, gulls and terns, swallows, blackbirds and starlings, bird species typically associated with riparian woodland and scrub (riparian birds), and bird species typically associated with grassland and agricultural habitats.

Ground surveys to determine the occurrence and relative abundance of general wildlife species on DW project islands were conducted during February-May 1988.

Bacon Island

Bacon Island is the most intensively farmed of the four DW project islands. Most of the island is farmed for potatoes and asparagus. The island supports a moderate diversity and density of wildlife species compared with the other project islands.

Low- to moderate-sized populations of most general wildlife species are found on Bacon Island. The number of gulls observed during ground surveys was higher than on the other project islands; gulls congregated in areas flooded for weed control in winter and spring.

Moderate numbers of raptors, shorebirds (primarily sandpipers), and wading birds were observed during ground surveys. No great egrets, snowy egrets, or great blue herons nest on Bacon Island, and no potential nesting habitat exists. Few piscivorous birds or birds associated with riparian habitats, open water, or grasslands were observed on the island.

Webb Tract

Webb Tract is less intensively farmed than Bacon Island and Bouldin Island but supports more agriculture than Holland Tract. Nearly half the island is farmed for corn and wheat. Approximately 105 acres of open water habitat exists at two blowout ponds located in the northeast quarter of the island. Most of the 106 acres of riparian woodland and scrub and 172 acres of freshwater marsh on Webb Tract surround these ponds.

The number of wading birds observed on Webb Tract during ground surveys was large relative to the numbers observed on the other project islands. The average number of herons and egrets recorded per survey station on Webb Tract was more than twice the number recorded on Bacon Island and four times the number recorded on Bouldin Island and Holland Tract. Most wading birds are found in the weedy marshland area on the north side of the island. No wading bird nesting colonies were found during aerial, ground, and boat surveys of all potential nesting habitats conducted during the nesting season.

More raptors were seen on Webb Tract than on the other islands; however, the number on Webb Tract was only slightly higher than the number on Holland Tract. The most common raptor species are black-shouldered kite, red-tailed hawk, and American kestrel.

Moderate numbers of birds were observed in riparian and wetland habitats on Webb Tract, but the numbers

recorded during systematic surveys were undoubtedly low because access was not granted by landowners to a blowout pond that provides high-quality wetland, riparian woodland, and open-water habitats on the eastern portion of the island. Small numbers of other species were observed during surveys, including piscivorous birds, shorebirds, gulls and terns, and blackbirds.

Bouldin Island

Wildlife habitats on Bouldin Island are dominated by agricultural lands that support corn, wheat, and sunflower. Smaller amounts of other habitats exist, including fallow agricultural land and herbaceous upland.

Low to moderate numbers of most bird species were observed on Bouldin Island during field surveys. A large number of gulls was observed; no terns were seen, and no breeding habitat for gulls was found on the island. Large numbers of grassland and agricultural birds, primarily blackbirds and American crows, were observed.

A moderate number of wintering raptors was observed on Bouldin Island. The number of raptors decreased in spring; the only non-special-status raptor species observed during May was red-tailed hawk, but the species did not nest on the island. A moderate number of swallows, primarily cliff swallows, were observed using Bouldin Island.

Small numbers of wading birds, shorebirds, and riparian and marsh birds were observed. No herons or egrets nested on the island. Killdeer were the only shorebirds observed. The most common birds observed in riparian habitats were white-crowned sparrow, house finch, song sparrow, American robin, and black phoebe.

Holland Tract

Holland Tract is the least intensively farmed of the four DW project islands. Agriculture accounts for approximately 31% (974 acres) of the island acreage. Holland Tract supports about 225 acres of herbaceous wetland, most of which is dominated by weedy species that invade fallow agricultural areas. In total, the island supports more woody riparian vegetation (105 acres) than any of the other three project islands, most of which is associated with a blowout pond located at the northeast end of the island. In 1987, DW constructed a shallow 63-acre demonstration wetland pond to evaluate vegetation establishment and growth under proposed operating conditions that would have been present under the original DW proposed project (see Appendix G2, "Vegetation Inventory Methods and Results").

High numbers of shorebirds, raptors, riparian and marsh birds, and blackbirds and starlings were observed on Holland Tract relative to the other project islands. The most common raptors included black-shouldered kite and red-tailed hawk. Raptors were most common in winter and declined to small numbers in April and May. A red-tailed hawk nest was found, and kites were suspected to have nested on the island.

Shorebirds use the Holland Tract demonstration wetland, including an average of 60 sandpipers and 14 dowitchers observed per survey; no nesting by shorebirds was observed. The most common riparian birds included house finch, American robin, song sparrow, and white-crowned sparrow. Large numbers of yellow-headed blackbirds and red-winged blackbirds were observed during winter; blackbird numbers declined during spring, but red-winged blackbirds remained and nested in weedy and marsh areas.

Moderate numbers of gulls, grassland birds, and swallows were observed on Holland Tract during winter. Wading birds were less abundant on Holland Tract than on the other project islands.

Delta Region, Suisun Marsh, and San Francisco Bay

The island area of the Delta consists of approximately 600,000 acres on 60 islands. At least 230 species of birds and 43 species of mammals are found in the Delta (DFG 1987a). The area provides habitat of importance to shorebirds in particular. Thousands of shorebirds use fields flooded for weed control in late summer and fall and fields that flood shallowly from seepage and rainfall in winter.

General wildlife species reported from the Delta are similar to those described for the DW project islands. Wildlife species and populations on different islands vary primarily according to the amounts and types of crops grown and amounts of natural habitats remaining. Rollins (1977) rated the values of several Delta habitats along the proposed route of the Peripheral Canal from most to least valuable. These habitats were riparian woodland, marsh, permanent pasture, cornfields, and asparagus fields.

Suisun Marsh lies between San Francisco Bay and the Delta. The area provides approximately 57,300 acres of wetland and adjacent upland habitat and 27,000 acres of bays and waterways for use by waterfowl and other

species (USFWS 1978). Suisun Marsh also supports a variety of general wildlife species characteristic of saltwater and freshwater marsh and herbaceous upland areas.

San Francisco Bay includes 53 square miles of tidal marsh, 15 square miles of diked marsh, and 55 acres of diked ponds (JSA et al. 1979). San Francisco Bay habitats support approximately 200 species of birds and 40 species of mammals (DFG 1987b). Important groups include waterfowl and special-status wildlife species. The bay supports hundreds of thousands of shorebirds during the migratory and winter seasons (Yee et al. 1988), and many nongame birds and mammals use the various marsh habitats.

Waterfowl

Long-Term Trends in Waterfowl Abundance in the Delta

The size of waterfowl populations wintering in the Delta fluctuates between years because of changes in weather, habitat conditions, and flyway populations. Despite annual fluctuation, large populations of waterfowl had used the Delta area in most years until the 1980s. Wintering waterfowl populations in the Delta have declined by approximately 83% since the 1970s (Figure 3H-1). The decline is most pronounced for ducks, but substantial declines are also evident for swans and geese.

Population declines in the Delta during the 1980s and early 1990s reflect the larger waterfowl population decline that has occurred in the Central Valley and Pacific Flyway. The decline is attributable to a variety of factors, the most important of which is probably the prolonged drought in northern breeding areas that resulted in unfavorable land use changes (i.e., intensified farming of former wetland areas and adjacent nesting habitats). Loss of winter habitat is also considered an important factor that has contributed to the population reduction and may prevent future recovery of populations. (Implementation Board of the Central Valley Habitat Joint Venture 1990.) Duck and goose populations have begun to recover in recent years. The wet years of 1993 through 1995 in northern breeding areas provided favorable breeding conditions that resulted in substantially higher production of ducks and geese. Wintering populations of ducks and geese in the Delta and Central Valley, however, are still substantially lower than the average wintering populations for the previous 40 years (Yparraguirre pers. comm.).

Analysis of past population trends is relevant to the DW project because the populations recorded in 1987-1988 were approximately 80% less than those that likely existed in the 1970s. The net result is that numbers reported for individual DW project islands in the following sections are below the numbers that occurred historically and that would likely occur if populations recover to meet management goals. Nonetheless, the survey results provide a valuable indication of the relative abundance of waterfowl on different islands and indicate habitats used by species.

Bacon Island

The estimated total of waterfowl use-days is moderate for Bacon Island. Tundra swans were observed using Bacon Island more than any other island except Webb Tract during the survey period, with an average observed population of about 300 birds. Nearly 90% of the swans were in cornfields flooded for weed control; flooded cornfields made up less than one-third of the island's area.

Geese have a moderate number of use-days on Bacon Island. White-fronted geese arrive in substantial numbers in mid-December to late December and use flooded and unflooded agricultural fields. Snow goose populations vary widely. All snow geese observed on Bacon Island used unflooded, undisked agricultural fields. No Canada geese were observed on Bacon Island.

Few ducks have been observed on Bacon Island. Flocks of pintails were seen twice in flooded potato fields, and mallards were seen in flooded fields and ditches. Only 10 mallards were seen during May surveys, indicating that few birds breed on the island.

Waste Grain Availability. A moderate amount of waste corn is available to waterfowl on Bacon Island (see Appendix H2, "Wildlife Inventory Methods and Results"). Approximately 82,000 pounds of corn are estimated to be available immediately after harvest, but postharvest disking for planting to winter wheat on approximately half the corn acreage reduces availability to approximately 67,500 pounds.

Fields of market potatoes on Bacon Island are not flooded; they are kept in a saturated soil condition for several weeks following harvesting to encourage rotting (Shimasaki pers. comm.). Therefore, these fields provide little food for waterfowl. Seed potatoes are harvested later and cannot be rotted because of cold temperatures; these areas probably provide valuable forage for waterfowl.

Hunting Harvest. No waterfowl or upland game are harvested on Bacon Island.

Webb Tract

Webb Tract supports high numbers of waterfowl use-days. Total waterfowl use observed on Webb Tract is 10 times higher than on any of the other islands. Of the four project islands, Webb Tract has the largest corn acreage and supported the largest number of swans during the midwinter survey period. Swans on Webb Tract use unflooded cornfields and flooded fields.

Webb Tract had the largest number of geese observed during aerial surveys of the four project islands. Three-fourths of the white-fronted geese observed were resting on the eastern blowout pond; the remaining birds were seen in undisked cornfields. The snow goose population averaged 4,700 during December through March, with a peak of 10,000 birds in mid-January. Snow geese were usually seen resting on the eastern blowout pond but were also observed in undisked and flooded cornfields. Several groups of Canada geese were seen; the largest group consisted of approximately 650 birds in an undisked cornfield. The survey data indicate that the eastern blowout pond on Webb Tract is an important resting area for geese in the Delta.

The number of ducks observed on Webb Tract was also high but varied substantially over the survey period. Both mallards and pintails were seen regularly. The largest population, consisting of 20,000 ducks (both pintails and mallards), was found resting on the eastern blowout pond in mid-December. Nearly all ducks on Webb Tract observed during winter were found resting on the eastern blowout pond.

Twenty-seven mallards seen during each of the two May surveys were assumed to be breeding birds; their presence indicates the existence of a moderate-sized breeding population (perhaps 20-50 pairs). Ten mallards (some of which may have been young-of-year) were observed on the eastern blowout pond during a survey conducted in June.

Waste Grain Availability. Webb Tract produces approximately 567,000 pounds of waste corn available for waterfowl and other wildlife, representing more than half the waste corn provided on the DW project islands (see Appendix H2, "Wildlife Inventory Methods and Results"). Wheat also provides seed following harvest in summer and green forage for geese and other wintering birds during late fall and winter.

Hunting Harvest. Harvest rates of ducks and geese are highest on Webb Tract among the four project islands. The harvest represents a small proportion of the total numbers of birds that use the island.

Bouldin Island

Estimated waterfowl use-days are moderate on Bouldin Island. Swan use on Bouldin Island is moderate compared with swan use of other islands; most swans were seen during the surveys in flooded grainfields, with fewer numbers in undisked grainfields.

The number of geese using Bouldin Island is low to moderate, and daily populations vary substantially over winter. A moderate number of white-fronted geese were seen during aerial surveys; the highest count was 1,100 birds in early January. Most white-fronted geese were observed in flooded, disked grainfields and undisked grain stubble.

The few snow geese observed on Bouldin Island used disked cornfields. Canada geese were seen in small numbers in disked and undisked fields, and several flocks were seen in grazed fallow fields during ground surveys. Canada geese may have been slightly undercounted during aerial surveys because they were not easily distinguishable among larger groups of white-fronted and snow geese.

Fowl cholera records show variability in the use of Bouldin Island by geese. In 1986, DFG personnel collected 2,000 dead white-fronted and snow geese, which represented only a portion of the birds using the island at that time (DFG file information).

Overall duck use observed at Bouldin Island is low. The number of ducks observed during surveys declined substantially in early January. Pintails are the most abundant species using the island. During surveys, mallards were observed in ditches and flooded fields. Only four mallards were seen in May, indicating a very small breeding population.

Waste Grain Availability. Approximately 214,000 pounds of waste corn are produced and available for waterfowl use on Bouldin Island (see Appendix H2, "Wildlife Inventory Methods and Results"). Approximately 1,200 acres of wheat, another important source of waste grain for waterfowl, are also grown on the island. Average corn availability shortly after harvest is 87 pounds per acre. Field measurements on the island yield an average of 106 pounds per acre of grain left in the half of the cornfields that are not disked after harvest

and 68 pounds per acre in remaining areas disked prior to the planting of winter wheat (JSA 1989).

Wheat is another important crop on Bouldin Island. Approximately half the corn acreage is replanted in wheat following harvest in the fall. Waterfowl, especially Canada and white-fronted geese, graze extensively on green wheat foliage during winter and early spring (Fredrickson et al. 1988, Miller pers. comm.).

Hunting Harvest. Small numbers of ducks and geese are harvested annually by hunters on Bouldin Island. Harvested birds represent only a small proportion of the total number of birds that use the island.

Holland Tract

The estimated total of waterfowl use-days on Holland Tract is low. Few tundra swans were observed at Holland Tract during the surveys. Nearly all birds were detected in flooded fields.

Few geese were observed using Holland Tract. Few or no white-fronted geese were seen during November to March, but numbers increased during April. Snow geese were not recorded on Holland Tract during aerial surveys, but 2,000 birds were seen feeding in an unharvested cornfield near the blowout pond during a ground survey in early February. Several small flocks of Canada geese were seen during December and January; however, nearly all Canada geese recorded during Holland Tract surveys were flying and may not have landed on the island.

Holland Tract supports moderate numbers of ducks. Most ducks were found during surveys in the Holland Tract demonstration wetland and the blowout pond, and the rest were observed in flooded fields. Species seen at the demonstration wetland included American widgeon, mallard, northern pintail, cinnamon teal, ruddy duck, and northern shoveller (JSA 1990).

Waste Grain Availability. Holland Tract produces approximately 67,000 pounds of waste corn for waterfowl. Wheat is the major crop and provides seed during spring and late summer for resident species and green forage for wintering species, especially geese. Corn harvesting is considered nonintensive, and the availability of waste corn for use by wildlife is estimated to be similar to availability on Webb Tract (see Appendix H2, "Wildlife Inventory Methods and Results").

Hunting Harvest. Few ducks, geese, and pheasants are harvested annually by hunters on Holland Tract. The estimated harvest represents only a small proportion of the total numbers that use the island.

Delta Region, Suisun Marsh, and San Francisco Bay

The Delta supports nearly 10% of the waterfowl that winter in the Pacific Flyway. The Delta provides important waterfowl habitat on flooded and unflooded agricultural lands, natural wetlands, and sloughs. Approximately 12,000 acres of agricultural lands are flooded by duck clubs in the Delta (USFWS 1978). Nearly 75% of all tundra swans and more than one-third of all white-fronted geese in the Central Valley winter in the Delta (DFG 1987a). The Delta also supports large populations of snow geese, pintails, and mallards (Gilmer et al. 1982, DFG 1987a).

Suisun Marsh supports more than 57,000 acres of managed wetland and upland. Substantial numbers of waterfowl use Suisun Marsh. The highest use occurs during early fall before the onset of rains, when the availability of shallow-water habitats attract waterfowl. Waterfowl populations at Suisun Marsh decline later in winter when additional flooded habitat is available. Suisun Marsh supported approximately 2% of the waterfowl population observed during the midwinter surveys in December 1973-1976. (USFWS 1978.)

San Francisco Bay provides important habitats for wintering waterfowl (DFG 1987b). The saltwater portions of the bay support a large proportion of the diving ducks wintering in California. Freshwater and brackish areas in the eastern portion of the bay provide important habitats for dabbling ducks and geese.

Upland Game

Upland game species include ring-necked pheasant, mourning dove, California quail, and desert cottontail.

Bacon Island

Low numbers of ring-necked pheasant, California quail, and mourning dove were observed on Bacon Island. The island is farmed intensively and cover is scarce; the number of pheasants observed on Bacon Island was lower than on the other DW project islands. No upland game species are harvested on Bacon Island.

Webb Tract

Webb Tract surveys recorded the highest number of mourning doves among the four islands, a moderate number of pheasants, and no quail. The high number of doves reflects the abundance of woodland perching sites and availability of grain in wheat fields. Among the four project islands, the harvest of pheasants is highest on Webb Tract.

Bouldin Island

Bouldin Island supports moderate numbers of ring-necked pheasants and mourning doves; no quail were seen on the island during surveys. Pheasant numbers are limited by the lack of cover on most parts of the island. Small numbers of pheasants are harvested annually by hunters on Bouldin Island.

Holland Tract

Pheasants and quail are more abundant on Holland Tract than on the other three DW project islands. The higher populations reflect the greater amounts of cover provided for pheasants by fallow areas and for quail by riparian shrubs and trees. Mourning dove populations are also high, presumably because of the abundance of perching sites in trees. Few pheasants, doves, and quail are harvested annually by hunters on Holland Tract.

Special-Status Species

Special-status species include species that are state or federally listed as threatened or endangered, Category 1 or 2 candidates for federal listing, DFG species of special concern, and species fully protected under the California Fish and Game Code. Fourteen special-status species occur or potentially occur on the DW project islands. Additional information regarding the status of the giant garter snake, bald eagle, Aleutian Canada goose, peregrine falcon, Swainson's hawk, and greater sandhill crane on the DW islands is presented in Appendix H3, "Federal Endangered Species Act Biological Assessment: Impacts of the Delta Wetlands Project on Wildlife Species", and Appendix H4, "California Endangered Species Act Biological Assessment: Impacts of the Delta Wetlands Project on Swainson's Hawk and Greater Sandhill Crane". Table H2-2 in Appendix H2, "Wildlife Inventory Methods and Results", describes the special-status species that occur or have the potential to occur on the DW project islands.

Bacon Island

Northern harrier and burrowing owl were the only special-status species observed on Bacon Island during the surveys. Potential habitat for 10 other special-status species, including Swainson's hawk and tricolored blackbird, exists. Greater sandhill cranes have not traditionally used Bacon Island, and none were observed during surveys. DFG, however, reports a recent isolated observation of a greater sandhill crane on Bacon Island (Wernette pers. comm.).

A small number of northern harriers was observed on Bacon Island. Harriers are not known to nest on Bacon Island because nearly all the island is cultivated and suitable nesting sites are limited. One burrowing owl was observed during surveys. Burrowing owls are not known to nest on Bacon Island because intensive agriculture and levee maintenance activities have minimized the availability of suitable burrows and the presence of ground squirrels that construct burrows.

Bacon Island provides low- to moderate-quality foraging habitat for Swainson's hawks. The nearest known Swainson's hawk nest site is located immediately to the east on Mildred Island, and seven pairs nest within 10 miles of the island. Although no Swainson's hawks were observed during surveys, Swainson's hawks nest within foraging distance and could use the island.

Webb Tract

Northern harrier was the only confirmed special-status species observed on Webb Tract. Webb Tract also supports potential habitat for 12 additional special-status species, including Swainson's hawk, peregrine falcon, and tricolored blackbird.

One sandhill crane (subspecies not identified) was observed during an aerial survey of Webb Tract. Although Webb Tract is not considered an important greater sandhill crane area by Pogson and Lindstedt (1988), it supports suitable foraging habitat, including grainfields, fallow fields, pastures, exotic marshes, and herbaceous uplands. DFG has recently designated Webb Tract as a greater sandhill crane wintering area based on additional sightings.

Webb Tract provides low- to moderate-quality Swainson's hawk foraging habitat. The nearest known nest site is located within 4 miles, and seven pairs nest within 10 miles of the island. Thus, several pairs could forage on Webb Tract. Webb Tract supports a high number of harriers in winter, with an average of 14 birds

seen per survey in February. Harriers could nest in densely vegetated wetlands or fallow fields on the island.

Bouldin Island

Greater sandhill crane, Swainson's hawk, and northern harrier were the only special-status species observed on Bouldin Island during surveys. Since surveys were conducted, other special-status species have been observed by JSA biologists; these species include peregrine falcon, Cooper's hawk, ferruginous hawk, and short-eared owl. Bouldin Island also supports potential habitat for five additional special-status species, including tricolored blackbird and Aleutian Canada goose.

Sandhill cranes were regularly observed during October-February, but numbers subsequently declined rapidly and none were seen after early March. All the cranes seen during one October visit were lesser sandhill cranes, but 95% of the birds identified to subspecies in February-March were greater sandhill cranes. Based on additional observations, DFG has designated Bouldin Island as a greater sandhill crane wintering area.

Swainson's hawks have been observed foraging on Bouldin Island during the breeding season and winter. One was observed flying over the island during surveys conducted in May 1988. Pasture, fallow fields, and agricultural fields provide suitable foraging habitat; vegetation in some fallow areas, however, may be too tall and dense to be used for foraging by Swainson's hawks. The nearest known Swainson's hawk nest site is approximately 3 miles north of Bouldin Island, and 10 pairs nest within 10 miles of the island. Thus, several pairs could forage on Bouldin Island.

Bouldin Island supports moderate numbers of harriers during winter and early spring; no birds were seen in May during surveys. Harriers are not known to nest on Bouldin Island.

Holland Tract

Special-status species observed on Holland Tract during the surveys were Swainson's hawk and northern harrier. Although western pond turtles were not observed during surveys, they are known to have been present on Holland Tract; however, the status of pond turtle populations on Holland Tract is unknown. Potential habitat for 12 additional special-status species, including valley elderberry longhorn beetle (VELB), tricolored blackbird, and short-eared owl, also exist on Holland Tract.

One adult Swainson's hawk was observed during surveys of Holland Tract. Suitable nesting habitat on the island exists in trees over 25 years old, but no nests were found. Fallow areas, pasture, grassland, and agricultural fields are suitable for foraging use by Swainson's hawks. The nearest known nest site is approximately 3 miles east of the island. Seven pairs nest within 10 miles of the island, although only two pairs have been located nesting within 9 miles. Thus, although several pairs nest within foraging distance of Holland Tract, it is probably less likely to be used than the other DW project islands.

No greater sandhill cranes were observed on Holland Tract during surveys; however, DFG has recently reported an isolated observation of a greater sandhill crane on the island. Holland Tract provides suitable crane foraging habitat; however, because it is located approximately 7 miles from the nearest important wintering area, the island is not expected to support regular use by greater sandhill cranes.

Holland Tract supported at least four northern harriers throughout the survey period.

Delta Region, Suisun Marsh, and San Francisco Bay

The Delta is known to support seven bird, one reptile, and three insect species state-listed or federally listed as threatened or endangered and four bird, two mammal, one reptile, and two insect species identified as federal candidates for listing (see Appendix H5, "Agency Correspondence regarding the Federal and California Endangered Species Acts"). The Delta area is used only irregularly by small numbers of peregrine falcons and bald eagles. The Delta supports a small number of nesting Swainson's hawk pairs; densities are substantially greater on higher elevation lands north and east of the Delta (Estep pers. comm.). Certain localized areas of the Delta serve as important wintering habitat for the greater sandhill crane (Pogson and Lindstedt 1988) and Aleutian Canada goose (Nelson et al. 1984).

Suisun Marsh and San Francisco Bay provide habitat for six bird species and one mammal listed as threatened or endangered by DFG or USFWS. The salt marsh harvest mouse; California clapper rail; and, to a lesser extent, the California black rail are found primarily in salt marsh habitats. The salt marsh common yellowthroat and Suisun song sparrow subspecies prefer tall emergent vegetation that grows in more brackish conditions.

IMPACT ASSESSMENT METHODOLOGY

Analytical Approach and Impact Mechanisms

Impacts on wildlife were evaluated through comparison of wildlife values associated with habitat conditions predicted under the DW project alternatives with existing habitat conditions. Existing wildlife habitats would change as a result of construction of facilities, upgrading of levees, inundation of reservoir islands during water storage and shallow-water management periods, and implementation of the HMP (see Appendix G3, "Habitat Management Plan for the Delta Wetlands Habitat Islands"). Potential impacts of the project's habitat modifications include changes in populations of general wildlife species, waterfowl, upland game, and special-status species.

Alternatives 1, 2, and 3

The analysis of impacts of the DW project alternatives on the reservoir islands was based on the amounts of Delta water that would be available for storage; the estimated amounts are based on the 70-year hydrologic record for the Delta (see Chapter 3A, "Water Supply and Water Project Operations", and Chapter 3B, "Hydrodynamics"). There is potential for some level of continuing subsidence on the DW project islands even with the cessation of farming activities. As a result, the water storage capacity of the reservoir islands could increase in future years. The rate of subsidence, however, would be substantially less than under existing conditions. Reduced rates of subsidence and increased water storage capacity on the reservoir islands would not be expected to substantially increase or decrease wildlife habitat effects analyzed in this chapter.

A detailed description of the approach used to analyze future habitat conditions on the DW reservoir islands is presented in Appendix G2, "Prediction of Vegetation on the Delta Wetlands Reservoir Islands". Although reservoir islands will support wildlife habitat, the actual duration and frequency of habitat conditions that would occur on reservoir islands is unpredictable. The general wildlife habitat values that would be associated with each reservoir island operating condition are described below. Because future habitat conditions are unpredictable and cannot be quantified, reservoir islands were assumed in this impact assessment to provide no wildlife values that would offset project impacts. Therefore, for the impact analysis, operation of the reservoir islands was not used to offset or compensate for impacts of the project on wildlife values.

Analysis of future vegetation conditions on habitat islands under Alternatives 1 and 2 is based on habitat types and acreages described in the HMP (see Appendix G3, "Habitat Management Plan for the Delta Wetlands Habitat Islands").

No-Project Alternative

Island habitat conditions predicted under the No-Project Alternative are based on a feasibility study prepared for DW by The McCarty Company, Diversified Agricultural Services (McCarty pers. comm.). The report, in general, recommends greater crop diversification, with a greater emphasis on perennial crops, for all four DW project islands.

HEP Analysis

This section describes the habitat evaluation procedures (HEP) methodology used to identify preproject and project habitat conditions on the DW islands under the 1990 and 1992 versions of the DW project. The HEP analysis was performed by a team consisting of representatives of SWRCB, USFWS, DFG, and JSA. HEP methodology was not used to evaluate the current DW project; however, the HMP team consulted the HEP results for the earlier versions of the project and conducted an informal, modified HEP evaluation of the current project to assist in identifying habitat types, acreages, and management required on the DW habitat islands to offset project impacts on waterfowl.

HEP Methodology. The HEP methodology is a systematic procedure for assessing the impacts of a project on a set of species (evaluation species) selected to represent wildlife communities that would be affected by the project. The procedure compares the quality and acreages of habitats under preproject and project conditions to determine changes in total habitat value for the evaluation species.

Ten HEP evaluation species were selected to represent the variety of game and nongame species that could be affected positively or negatively by habitat changes that could occur under various project alternatives. Species evaluated in the HEP analysis, the wildlife groups (i.e., guilds) they represent, and the general habitats they use are listed in Table 3H-1.

Per-acre quality of habitats for each species under preproject and project conditions was determined using habitat suitability index (HSI) models developed for each species. The HSI models consisted of:

- variables important in determining habitat quality for the species at the project site (e.g., vegetation height, water depth),
- habitat suitability ratings for different conditions of each variable (variable values) for the species on a scale from 0.0 to 1.0, and
- equations used to combine individual variable suitability ratings to create the HSI value or the overall rating of habitat quality for the species.

Habitat quality was assessed for each of nine 4- to 6-week-long annual periods. The periods were identified to allow tracking of habitat values resulting from substantial changes in habitat conditions that occur at different times of the year and to evaluate habitat quality for each species during its expected period of occupancy at the islands.

Habitat suitability ratings were calculated for each habitat type and subtype present on the islands under preproject and postproject conditions. The models were calibrated through comparison of HSI values for existing and potential habitats (including potential mitigation areas) and adjusted by modification of HSI values for individual variables or modification of the HSI equation. HSI values described the per-acre value of each habitat type. Habitat unit (HU) values (HSI values multiplied by acres) were calculated for each evaluation species to describe the overall habitat value of each habitat type to the species during each of the annual analysis periods. HU values for each habitat type were then added to describe the total value provided in each of the nine annual analysis periods for each species.

Related Documents. Details concerning selection of evaluation species, development of species models, procedures used to conduct HEP analyses, and results of the HEP analysis for the earlier version of the DW project were presented in the original draft EIR/EIS for the DW project and in the following documents:

- draft HEP report for the DW project (JSA 1991),
- appendices to the draft HEP report for the DW project (JSA 1991), and
- draft HEP report for the revised DW project (JSA 1993a).

HMP Development

HMP Objectives. SWRCB staff redesignated the HEP team as the HMP team in November 1993 and instructed the team to develop an HMP for Bouldin Island and Holland Tract that would compensate for project impacts.

The HMP team's primary objective was to design the habitat islands to:

- compensate for the loss of foraging habitat on the reservoir islands for Swainson's hawk and greater sandhill crane, which are protected under California Endangered Species Act (see Appendix H4, "California Endangered Species Act Biological Assessment: Impacts of the Delta Wetlands Project on Swainson's Hawk and Greater Sandhill Crane");
- compensate for foraging habitat for wintering waterfowl; and
- mitigate project impacts on jurisdictional waters of the United States, pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899.

The HMP team's secondary planning objectives included creating habitats for upland wildlife species; enhancing habitat for waterfowl breeding, greater sandhill crane roosting, and Swainson's hawk nesting; and providing habitat for other special-status species. Results of the 1990 HEP analysis of preproject conditions were used by the HMP team as a guide to ensure that the HMP team's habitat designs and habitat management guidelines for the habitat islands would compensate for project impacts on wintering waterfowl habitat.

Use of HEP Results. The HMP team assumed that compensation could be achieved for project impacts on wintering waterfowl if white-fronted goose habitat values present under preproject conditions during December (the period of greatest impact) were replaced on the habitat islands. The HEP analysis indicated that between 3,380 and 4,411 HUs for white-fronted goose would need to be replaced on the habitat islands to compensate for project impacts. (Reservoir islands would also provide limited wintering waterfowl foraging habitat; because future habitat conditions on the reservoir islands are unpredictable, however, the HMP team assumed that the

reservoir islands would provide no wildlife values that would offset project impacts.)

The HMP team established HSI values for each of the proposed compensation habitats for December. The team designed the HMP for the habitat islands based on these values, as well as other factors to incorporate best management practices for overall wildlife habitat benefits. Following each of several design iterations, a modified HEP analysis was conducted to determine whether compensation was achieved in the overall HMP for the habitat islands. The team's final design provides 4,611 HUs for white-fronted goose during the December analysis period and exceeds the compensation requirement objective for waterfowl. The HMP also meets the other two compensation objectives described above for species protected under the California Endangered Species Act and for jurisdictional wetlands. The plan also represents consensus between SWRCB and DFG regarding adequate mitigation for impacts of reservoir island water storage operations.

Criteria for Determining Impact Significance

SWRCB and the Corps determined that for this analysis an alternative would be considered to have a significant adverse impact on wildlife if it would:

- substantially decrease the acreage of herbaceous upland habitats in the Delta region,
- decrease the acreage of wetland and riparian habitats on the DW project islands,
- decrease forage quality or quantity available to wintering waterfowl on the DW project islands,
- substantially disrupt wildlife use patterns in the Delta,
- increase the potential for outbreaks of wildlife diseases, or
- result in permanent loss of occupied special-status species habitat or direct mortality of special-status species.

An alternative would be considered to have a beneficial impact if it would result in a substantial increase in the quantity or quality of herbaceous upland, wetland, riparian woodland and scrub, wintering waterfowl, or special-status species habitat.

IMPACTS AND MITIGATION MEASURES OF ALTERNATIVE 1

Changes in Wildlife Habitat Conditions and Use

Bacon Island and Webb Tract

Habitat Condition Classes. Five types of habitat conditions are predicted to occur on reservoir islands under the proposed project: full storage, partial storage, shallow storage, nonstorage, and shallow-water wetlands (see Appendix G2, "Prediction of Vegetation on the Delta Wetlands Reservoir Islands"). The definitions of these habitat conditions are applicable only to the analysis of project impacts on wildlife and vegetation resources. For this analysis, it was assumed that during periods when water was available for storage, water would be simultaneously diverted onto Bacon Island and Webb Tract as a "worst-case" operating scenario. This operating scenario would have the greatest impact on wildlife habitat. DW may, however, sequentially fill reservoir islands. If reservoir islands were sequentially filled, wildlife impacts would be lessened.

The frequency of full-, partial-, and shallow-water-storage periods would increase and the frequency of nonstorage and shallow-water wetland periods would decrease, however, if DW reservoir islands were used for storage of water for transfer or for water banking (see Chapter 2, "Delta Wetlands Project Alternatives"). Although the frequency and magnitude of such activities is uncertain at this time and these activities would require separate authorization, implementation of the HMP would fully compensate for wildlife impacts associated with the operation of the DW project for water transfer or banking.

Tables 3H-2 and 3H-3 present the monthly frequency with which each of the five conditions would be expected to occur on the reservoir islands.

Following are descriptions of the five habitat conditions on the reservoir islands:

- Full-storage conditions would completely inundate all portions of reservoir islands except riprapped levee slopes.
- Partial-storage conditions would provide shallow to deep water storage pools and exposed

island bottoms and riprapped levee slopes above the storage elevation.

- Shallow-storage conditions would provide shallow-water habitats similar to shallow-water wetland habitats (see below) except that waterfowl forage availability would be lower.

- Nonstorage conditions would occur during periods when no water is stored and water is not used to create shallow-water wetlands.

- Shallow-water wetland conditions would occur during periods when no storage occurs and water is diverted onto the reservoir islands to flood vegetation and attract waterfowl and other wetland-associated wildlife. Shallow-water wetlands would be created at DW's discretion. For this analysis, however, it was assumed that DW would create shallow-water wetlands in every year in which no water has been stored for 60 or more consecutive days during the growing season (May through October).

Because water may be stored during any period of the year, populations of less mobile wildlife species, such as some small mammals and reptiles, would be greatly reduced or possibly extirpated from reservoir islands under the DW project alternatives. Consequently, reservoir islands are presumed to provide low-quality foraging habitat for raptors that prey primarily on small mammals.

Full-Storage Conditions. Reservoir islands under full-storage conditions would provide foraging habitat for piscivorous birds, such as pelicans, cormorants, and grebes. The reservoirs would provide low-quality swan, goose, and duck foraging habitat for all species except diving ducks. The reservoir water surface, however, would provide suitable dabbling duck resting habitat. Little or no habitat would be available for use by terrestrial wildlife species.

Full-storage periods that follow shallow-water wetland periods on reservoir islands would provide diving duck foraging habitat. Diving ducks would feed on abundant submerged vegetation at the seasonal pool edges and other areas 3-8 feet deep and on invertebrates that would be attracted by the presence of vegetation. This conclusion is suggested by waterfowl survey data from the demonstration wetland on Holland Tract, which contained several hundred diving ducks, including canvasbacks, ruddy ducks, and lesser scaup, following flooding to a 4-foot depth in January-March 1989 (see Appendix H2, "Wildlife Inventory Methods and Results"). The creation of deep-water habitat favorable to diving ducks would provide conditions similar to the habitat that historically supported large diving duck populations in the Delta. Few diving ducks are expected to nest on reservoir islands.

Partial-Storage Conditions. The greatest range of habitat conditions would exist during partial-storage periods because water depths of the reservoirs under partial-storage conditions may range from a few inches to over 10 feet and portions of island bottoms would be exposed. Portions of reservoirs over 3 feet deep would provide wildlife habitat conditions similar to those described for full storage and shallower areas would provide values similar to, but of poorer quality than, those of shallow-water wetlands (described below).

The rate at which watergrass, smartweed, and other important waterfowl food plants would become reestablished on reservoir islands following complete or partial drawdowns of stored water during the growing season is unknown. Reduction in vegetation density would be expected on the reservoir islands during nonstorage and partial-storage periods as a result of gradual loss of seeds and other plant propagules caused by deterioration associated with inundation, export from the islands during water releases, and periodic disruption of seed production with storage events during the growing season. At DW's discretion, however, reservoir islands may periodically be seeded with watergrass and other waterfowl food plants during spring and summer nonstorage periods to enhance the value of shallow-water wetlands. Partial-storage periods that follow shallow-water wetland periods in which wetlands were seeded, therefore, would be expected to be more productive than in years when reservoir islands are not seeded.

Portions of reservoirs less than 3 feet deep would be suitable for use by foraging swans, geese, and dabbling ducks. The quantity of waterfowl forage that would be available, however, is unpredictable. During partial-storage periods, areas that are exposed following drawdown of water from November through April would remain largely unvegetated.

Saturated and unvegetated portions of exposed reservoir island bottoms would provide suitable foraging habitat for migrant and wintering shorebirds. Herbaceous habitat that may develop above storage pool elevations would be invaded by wildlife species present in the adjacent levee habitats. Populations of species such as voles, gophers, pheasants, grassland songbirds, and raptors would make increased use of the uninundated areas. Populations in these areas, however, would remain below the available carrying capacity because source populations would be low.

Reservoir islands under partial-storage conditions would provide more shallow-water habitats during the nesting seasons for shorebirds and ducks. Because of its irregular availability, this newly available habitat would be discovered and colonized only by small numbers of breeding water birds.

Mudflats and shallow-water areas created during reservoir drawdown periods would be expected to provide foraging areas for red-winged blackbirds and Brewer's blackbirds, and possibly for tricolored blackbirds.

Shallow-Storage Conditions. Shallow-storage conditions would occur when water volumes equal to or less than those used to create shallow-water wetlands are stored on the reservoir islands. Habitat conditions would be similar to those described for shallow-water wetlands (see below) except that water would not be managed in cells (i.e., no dikes would be maintained) and the availability of wildlife forage would be lower during storage periods that were not preceded by 60 days of nonstorage.

Nonstorage Conditions. During nonstorage periods that occur after the growing season and follow full-storage and partial-storage events, exposed reservoir island bottoms would remain largely unvegetated. Exposed areas with saturated soils would provide suitable habitat for migrant and wintering shorebirds and blackbirds.

During nonstorage periods in the growing season, herbaceous habitats that would become established on reservoir islands would provide wildlife values similar to those described for partial-storage conditions.

Permanent open-water habitat would be created in reservoir island borrow areas and in the drainage circulation network with implementation of the DW project as a result of seepage. Water depths would range from 2 feet to 4 feet but these areas would probably not be able to support emergent vegetation because of previous storage events on the reservoir islands. Wildlife values associated with borrow areas and the drainage network would be similar to those described for partial storage. These open-water areas would also provide brood habitat for ducks and other water bird species; however, the habitat would be of low quality because it would lack emergent vegetation.

Shallow-Water Wetland Conditions. Approximately 3,700 acres on Bacon Island and 3,850 acres on Webb Tract may be managed as shallow-water wetlands during years when 60 or more consecutive days of nonstorage conditions have occurred during the growing season immediately before any date between September 15 and November 30. This analysis assumes that DW would use its existing riparian water rights, which are available after September 15, to create shallow-water wetlands (see Appendix G2, "Prediction of Vegetation on the Delta Wetlands Reservoir Islands"). Approximately 60 days of nonstorage during the growing season would be required for watergrass and other waterfowl food plants to develop seed.

DW would construct an inner levee system on the reservoir islands to create wetland cells through which water would be circulated to maintain water quality, which will reduce the likelihood of botulism outbreaks and allow reservoir islands to be rapidly drained to eliminate wetland habitat in the event of an outbreak of botulism, avian cholera, or other water bird disease. The inner levee system and associated water control structures will be designed and managed to ensure that at least 65% of the reservoir island acreage would be flooded to create shallow-water wetlands. At least 50% of the flooded area would be maintained at an average water depth of 12 inches. In years during which no storage occurs, reservoir islands would be managed as wetlands through winter and would be drawn down by May. In suitable years in which DW does not create shallow-water wetlands, reservoir island conditions would be as described for nonstorage conditions. Under shallow-water wetland conditions, wildlife values associated with open-water habitats in borrow areas and the drainage circulation network would be as described for nonstorage conditions.

Shallow-water wetlands could be created and managed on the reservoir islands to specifically provide waterfowl foraging habitat. At DW's discretion, shallow-water wetlands would be seeded with waterfowl forage plants. Seeded wetlands would be dominated by watergrass, smartweed, and other wetland waterfowl food plants following seeding of these plants by DW. If reservoir islands are not seeded, herbaceous vegetation would be relatively sparse compared with the vegetation that would be established in dense stands in wetlands following seeding of the islands. Consequently, wildlife values provided by wetlands would be expected to be substantially lower than in years when wetlands are seeded. Dominant plant species in years wetlands were not seeded would be species with seeds that are imported onto the islands in diverted water or species with seeds that are windborne onto the islands. The numbers of swans, geese, and dabbling ducks that would forage in shallow-water wetlands and the period forage would be available would be substantially greater in years when wetlands are seeded than in years when plants become reestablished naturally.

In years during which no storage occurs, areas of herbaceous vegetation not flooded to create shallow-water wetlands would provide nesting habitat for waterfowl; ground-nesting raptors, such as northern harriers and short-eared owls; ring-necked pheasants; and other upland nesting species.

Shallow-water wetlands would provide foraging habitat for wading birds. Herons and egrets would be attracted to feed on larger invertebrates associated with shallow-flooded wetlands. Gulls and terns would also use wetlands to forage on invertebrates. Some shorebird foraging habitat would be provided in shallow-flooded areas (less than 6 inches deep) that were unvegetated or sparsely vegetated. Blackbirds would use shallow marsh areas and herbaceous upland areas for feeding. Swallow nesting sites (e.g., buildings, cement wall overhangs) on reservoir islands are limited. Nesting sites would increase with the construction of pump and siphon stations and recreation facilities, so breeding swallow populations are expected to increase. Migratory swallow populations that use the reservoir islands would be expected to increase in response to increases in flying insects hatched from shallow water bodies and dense vegetation.

Use by General Wildlife Species. Habitat conditions and populations of wildlife species on the reservoir islands under Alternative 1 would differ substantially from those currently present. Use by species groups would depend on season and habitat conditions (i.e., full storage, partial storage, shallow storage, nonstorage, and shallow-water wetland).

Piscivorous Birds. Overall use of the reservoir islands by piscivorous birds (e.g., grebes, cormorants, and pelicans) would increase substantially from the existing low use level. These species would feed in the borrow areas during shallow-storage, nonstorage, and shallow-water wetland periods and in the reservoirs during full-storage and partial-storage periods. Little or no nesting of most of these species would occur on the reservoir islands.

During periods in which the reservoirs are being drawn down, white pelicans and double-crested cormorants would be expected to forage on concentrations of mosquitofish and bullfrog larvae; similar foraging behavior was observed at Dead Horse Island during drawdown of wetlands in July 1988 (JSA 1990).

Wading Birds. Numbers of wading birds would be expected to increase during certain periods. Herons and egrets would be attracted to feed on larger invertebrates in shallow-flooded areas during periods when the reservoir islands are managed as shallow-water wetlands. Although waterfowl hunting would discourage use somewhat, wading birds would become accustomed to hunting activity and would continue to use the area, especially on nonhunt days. During partial-storage periods, suitable habitat would be limited to reservoir margins. Use during the full- and partial-storage periods on the reservoir islands would be substantially lower than under existing conditions.

During nonstorage periods, wading bird use would decrease as the amount of shallow water declined. Nonetheless, substantial numbers of wading birds would forage along the margins of the borrow ponds and interior ditches, where resident fish populations would be concentrated. During this period, the margins of borrow ponds and ditches on the reservoir islands under Alternative 1 would provide a substantially greater amount of habitat than the margins of ditches and sloughs that currently exist on the islands (see Chapter 3G, "Vegetation and Wetlands").

Operations of Alternative 1 would reduce use of the reservoir islands by wading birds below preproject conditions during full-storage and deep-water, partial-storage periods and would be expected to increase use levels during nonstorage, shallow-water wetland, and shallow-storage periods.

Raptors. Raptor use of the reservoir islands would decrease because of habitat changes caused by water storage operations. Most raptors are found on the islands in winter, when they forage for rodents and large insects in fallow grassland and agricultural habitats. Winter flooding of the islands would force most wintering raptors to move elsewhere. Although most migratory raptors are adapted to moving in winter to locate adequate prey populations, it is uncertain whether displacement during winter would increase raptor mortality (Newton 1979).

Raptors would be expected to use unflooded areas on the reservoir islands to a limited extent during some partial-storage, shallow-storage, nonstorage, and shallow-water wetland periods. Rodent populations would be minimal because they would be largely eliminated during full-storage periods.

Shorebirds. Small numbers of shorebirds would use shallowly flooded areas on reservoir islands during spring and fall migration and in winter. Shallowly flooded areas (less than 6 inches deep) with little vegetation cover that may be present under some partial-storage, shallow-storage, nonstorage, and shallow-water wetland periods would be used by shorebirds. No

shorebird habitat would exist on the reservoir islands during full-storage periods.

During and following drawdown of stored water, exposure of mudflats could attract thousands of migrant shorebirds; similar wetland drawdown areas on the 180-acre Dead Horse Island were used by hundreds of dowitchers and other shorebirds that fed on worms and other invertebrates in 1988 (JSA 1990). Shorebird habitat areas would decline over time as vegetation became reestablished on island bottoms.

Gulls and Terns. During partial-storage, shallow-storage, and shallow-water wetland periods, gull feeding use of the reservoir islands would probably decline somewhat because of the loss of agricultural waste grain, but this loss would be partially offset by the increased availability of invertebrates in shallowly flooded areas. Gulls currently use agricultural lands for resting and would probably use seasonal pool bottoms similarly. Under full-storage conditions, food availability would decline for gulls; resting use would probably continue on the reservoir islands on calm days or in areas protected from wind.

During discharge periods, gulls would find abundant invertebrate food in the drawdown areas and populations would be expected to increase. After drawdown is completed, overall use would be expected to be higher.

Terns were not recorded on Bacon Island but their numbers there could increase substantially. Caspian terns could breed on islands exposed during partial-storage or drawdown periods; island survey results indicated that they were attracted in spring to the demonstration wetland on Holland Tract (see Chapter 3G, "Vegetation and Wetlands" for a description of the demonstration wetlands). However, in some years, nests would be destroyed as a result of subsequent diversions of water onto the reservoir islands during the breeding season.

Blackbirds and Starlings. During periods in which reservoir islands are managed as shallow-water wetlands and possibly during some shallow-storage periods, blackbird numbers could increase if agricultural foods were replaced by more abundant foods in shallow marsh areas. Red-winged, Brewer's, and possibly tricolored blackbirds would use shallow marsh and upland areas for feeding. Little blackbird habitat would be available during full-storage periods. Many blackbirds would be attracted to mudflats and shallow-water areas during drawdowns and during nonstorage periods in the growing season, when insect populations would be substantial.

Populations of the introduced European starling, a species that is more closely associated with agricultural lands than blackbirds, are expected to decline because of the loss of agricultural foods. The starling decline would be beneficial to native wildlife because it would reduce competition with native cavity-nesting birds (Remsen 1978, Weitzel 1988).

Riparian and Marsh Birds. Existing riparian woodland and scrub and freshwater marsh habitat on reservoir islands would be eliminated by project construction and inundation under project operations. Riparian shrubs and trees would not be expected to colonize interior levee slopes because interior levee slopes will be riprapped.

Grassland and Agricultural Birds. All species in the grassland and agricultural bird group are regionally common. Few bird species currently breed in grassland and agricultural habitats on the reservoir islands. In addition to western meadowlarks, blackbirds, starlings, pheasants, and waterfowl, several species that use grassland and agricultural lands during migration and in winter, including horned lark, American crow, yellow-billed magpie, and water pipit, would use these lands less because of habitat loss resulting from operation of the reservoir islands for water storage.

During some shallow-storage periods and when reservoir islands are managed as shallow-water wetlands, use by migratory species would be expected to increase in years when wetland plants are abundant; savannah sparrows, for example, were abundant in watergrass and smartweed stands during surveys of the Holland Tract demonstration wetland.

Use by Waterfowl. Habitat conditions under Alternative 1 would substantially alter waterfowl populations and seasonal use patterns on reservoir islands. Waterfowl habitat impacts would result from replacement of existing crops and fallow areas by shallow to deeply flooded habitats and shallow-water wetlands. Habitat impacts are described generally in Chapter 3G, "Vegetation and Wetlands".

Approximately 7,530 acres of waterfowl foraging habitat would be created during some shallow-storage periods and periods in which reservoir islands are managed as shallow-water wetlands (JSA 1993a). Waterfowl forage values provided by shallow-water wetlands would diminish substantially following 1 or more years of project operation as a result of seed losses caused by seed deterioration during inundation, seed export from islands during releases, and inundation during the growing season. If DW chooses to periodically seed reservoir

islands with watergrass, smartweed, and other important waterfowl food plants during nonstorage periods, overall habitat quality of shallow-water wetlands would be moderate to high for different waterfowl species.

Habitat quality on reservoir islands would decrease substantially for all waterfowl species, except diving ducks, during water storage periods.

Swans. Swans would use the reservoir islands during shallow-water wetland management and some shallow-storage periods to feed on seeds and tubers from marsh plants, although overall foraging habitat value would be less than that of harvested grain fields. Hunting would disturb birds to some extent, but if DW chooses to limit the number of hunting days per week, it would ensure that swans would regularly return to feed in shallow marshland areas. Feeding habitat conditions for swans on the island would decline substantially during storage periods.

Geese. White-fronted geese are expected to use the reservoir islands during some shallow-storage periods and when the islands are managed as shallow-water wetlands, although use there would be lower than in harvested grain fields. Snow geese, in contrast, are more dependent on waste grain (Bellrose 1976) and are expected to make less use of the shallow marsh areas available during shallow-water wetland periods. Canada geese would also not be expected to make extensive use of shallow-water wetlands on the reservoir islands.

Deep flooding during full- and some partial-storage periods would greatly reduce use of the reservoir islands for feeding by geese. The reservoir shorelines under partial-storage conditions would provide a small amount of foraging habitat during this period.

Dabbling Ducks. During some shallow-storage and shallow-water wetland management periods, dabbling duck use of the reservoir islands would increase. The extent of use would depend on the availability of forage. The presence of shallow-water habitat for dabbling ducks in early fall would provide benefits to duck populations because such habitats are often limited in the Central Valley at this time, particularly in dry years (JSA 1993b).

Certain dabbling ducks, including mallards, cinnamon teal, and lesser numbers of gadwalls, would nest in vegetation adjacent to flooded areas during partial-storage, shallow-storage, and shallow-water wetland periods. However, in some years, nests would be destroyed as a result of subsequent diversions of water onto reservoir islands during the nesting season.

Hunting would affect dabbling duck use and distribution on the reservoir islands during the hunting season. If DW chooses to limit the number of days reservoir islands are hunted per week, however, substantial waterfowl use would be maintained on the islands.

Shallow-water habitat at the edges of the reservoirs during partial-storage periods would support moderate numbers of dabbling ducks, as suggested by waterfowl use observed at the Holland Tract demonstration wetland.

During full-storage periods, dabbling duck foraging habitat quality would be substantially reduced; however, dabbling ducks would make extensive use of the reservoir water surfaces for resting. On windy days, such use would be restricted to the windward sides of the islands, which would be protected by levees.

Diving Ducks. Diving ducks currently make little use of the reservoir islands because little suitable habitat exists. Diving species, including scaup, ring-necked duck, ruddy duck, redhead, and canvasback, would be expected to use permanently inundated borrow areas during shallow-storage, nonstorage, and shallow-wetland periods and would use the intermediate-depth portions of the reservoirs during full- and partial-storage periods.

Coots. Coot populations would be expected to increase substantially on the reservoir islands during shallow-water wetland, shallow-storage, and partial-storage periods. Large numbers of coots would be attracted to shallowly flooded areas. An average of 200 birds per day were seen during surveys of the Holland Tract demonstration wetland following deep flooding (see Appendix H2, "Wildlife Inventory Methods and Results"). Coots would also be expected to graze extensively on newly sprouted plants adjacent to reservoir shorelines during the growing season.

Use by Upland Game. The breeding population of ring-necked pheasants on the reservoir islands would decline substantially as a result of periodic inundation of the reservoir islands. At DW's discretion, the reservoir islands may be seeded with watergrass and other waterfowl food plants during nonstorage periods that occur in the growing season. Watergrass seed is an important pheasant food in California (Mallette n.d.); thus, pheasants from surrounding islands may be attracted to feed on watergrass seed during nonstorage and shallow-water wetland periods. The availability of pheasant forage would be expected to be substantially less if islands are not seeded (see Appendix G2, "Prediction of Vegetation on the Delta Wetlands Reservoir Islands"). The area would be especially attractive to pheasants during fall,

when crop harvest would reduce cover on nearby islands. The number of pheasants attracted to the islands in fall would be lower than the number in the current population.

Quail populations on the reservoir islands would decline, and the species may become extirpated from the reservoir islands. Mourning dove populations would be expected to increase during nonstorage and seasonal wetland periods during years in which abundant weed seeds were available.

Use by Special-Status Species

Valley Elderberry Longhorn Beetle. VELB was not found to occur on the reservoir islands; therefore, no impact on this species would occur under any of the operational conditions (see Appendix H3, "Federal Endangered Species Act Biological Assessment: Impacts of the Delta Wetlands Project on Wildlife Species").

Giant Garter Snake. Habitat on the reservoir islands is considered marginal for the giant garter snake, and no snakes were observed during ground surveys. Implementation of Alternative 1 would result in creation of variable habitat conditions for the giant garter snake (see Appendix H3). Shallow flooding during partial-storage, shallow-storage, and shallow-water wetland periods would provide low-quality habitat, but very little suitable habitat would be available following deep flooding during some partial- and full-storage periods. The borrow area network could provide suitable habitat during nonstorage, shallow-storage, and shallow-water wetland periods.

Aleutian Canada Goose. Aleutian Canada geese are transitory and are found only in small numbers in the Delta. The last reported observation of Aleutian Canada geese using DW project islands is from 1983, when a small flock was observed on Bouldin Island (Appendix H3). The overall availability of foraging habitat would decline with the loss of corn and other crops of high forage value with implementation of Alternative 1. During shallow-water wetland periods, reservoir islands would provide moderate-quality foraging habitat; however, little suitable foraging habitat would be available during storage and nonstorage periods.

Bald Eagle. Bald eagles do not occur regularly in the Delta and none were observed on DW project islands during surveys. The reservoir islands currently support low-quality bald eagle foraging habitat. During shallow-water wetland periods, reservoir islands would provide moderate foraging habitat when ducks (especially birds injured by hunters) would be common and resident fish would be concentrated in borrow ponds and shallow areas. During storage periods, reservoir islands would provide low-quality foraging habitat along reservoir shorelines, where diving ducks and resting coots would typically congregate (Appendix H3).

Northern Harrier. No suitable nesting habitat for northern harriers currently exists on Bacon Island. Webb Tract currently supports approximately 1,100 acres of moderate-quality nesting habitat and harriers may breed on the island. Moderate-quality habitat consisting of untilled cropland currently exists for winter foraging. Bacon Island and Webb Tract had less than 2% of the Delta-wide total of untilled agricultural land in December 1987. During nonstorage, shallow-storage and shallow-water wetland periods, Alternative 1 operations would create suitable foraging habitat, but potential prey populations for harriers would be low because of previous water storage events. Harriers are wide ranging and, during storage periods, would move to other areas to forage.

Swainson's Hawk. Swainson's hawks are not known to nest on the reservoir islands. Agricultural, fallow, and herbaceous upland habitats present on the islands provide low- to moderate-quality foraging habitat (Appendix H4, "California Endangered Species Act Biological Assessment: Impacts of the Delta Wetlands Project on Swainson's Hawk and Greater Sandhill Crane"). Under implementation of Alternative 1, inundated portions of reservoir islands during full-storage, partial-storage, and shallow-water wetland conditions would be unsuitable as Swainson's hawk foraging habitat. Under all project conditions, unflooded areas would provide low-quality foraging habitat as a result of rodent populations would be substantially reduced because of inundation.

Peregrine Falcon. Peregrine falcons do not occur regularly in the Delta and none were observed on the DW project islands during surveys. The reservoir islands currently support low- to moderate-quality foraging habitat for peregrine falcons during winter (Appendix H3, "Federal Endangered Species Act Biological Assessment: Impacts of the Delta Wetlands Project on Wildlife Species"). During shallow-water wetland and some partial-storage periods, reservoir islands would attract ducks, shorebirds, and blackbirds, all of which would be potential prey for peregrine falcons. Deep flooding would attract diving ducks and thus provide low- to moderate-quality foraging habitat.

California Black Rail. No suitable black rail habitat currently exists on the reservoir islands, and none would be created. Potentially occupied habitat, however,

exists on small islands supporting marsh vegetation located in Delta channels adjacent to the reservoir islands. Black rails that may nest on these islands, therefore, could potentially be affected by construction activities (e.g., levee refurbishment and siphon construction) on the water side of reservoir islands. However, no impacts on this species would occur on the reservoir island interiors under any of the operational conditions.

Greater Sandhill Crane. Greater sandhill cranes do not currently make regular use of Bacon Island or Webb Tract. However, existing corn and wheat fields provide suitable foraging habitat for this species (Appendix H4, "California Endangered Species Act Biological Assessment: Impacts of the Delta Wetlands Project on Swainson's Hawk and Greater Sandhill Crane"). Shallow flooding associated with wetland and some partial-storage periods would provide suitable foraging and resting areas on the reservoir islands. The reservoir islands would be unsuitable for greater sandhill cranes during full-storage periods.

Burrowing Owl. Reservoir islands currently support marginal foraging and breeding burrowing owl habitat. Implementation of Alternative 1 would result in the creation of low-quality or unsuitable habitat for burrowing owls on the reservoir islands year round on the island bottoms.

Tricolored Blackbird. The reservoir islands currently provide suitable foraging habitat and low-quality breeding habitat for tricolored blackbirds. Implementation of Alternative 1 would provide low-quality tricolored blackbird habitat during shallow-water wetland and shallow-storage periods and some and partial-storage periods. Reservoir islands would be unsuitable for tricolored blackbirds during full-storage periods.

Bouldin Island and Holland Tract

HMP Implementation. Habitat islands would be managed primarily to offset impacts on wildlife associated with operation of the reservoir islands under Alternative 1. Implementation of the HMP and mitigation measures would fully offset impacts on wildlife associated with operation of the reservoir islands and would also provide benefits to wildlife that are not required to compensate for project impacts, including development of waterfowl nesting habitat and greater sandhill crane roosting habitat. As previously stated, operation of the reservoir islands for habitat values is not required to compensate for project impacts.

The primary goals of the HMP are to describe habitat island habitats and management requirements necessary to offset impacts of reservoir island operations on state-listed threatened species (i.e., impacts on Swainson's hawk and greater sandhill crane foraging habitat), wintering waterfowl foraging habitat, and jurisdictional wetlands pursuant to Section 404 of the Clean Water Act. Major elements of the HMP include:

- creation of approximately 9,000 acres of agricultural and nonagricultural habitats for species that would be affected by the project,
- creation of Section 404 jurisdictional riparian woodland and scrub and wetland habitats,
- implementation of special habitat management practices that would increase wildlife habitat values beyond those typically associated with created habitats (e.g., specified flooding schedules for seasonal wetlands),
- regulation of hunting and other recreational activities to reduce the effects of human disturbance of wildlife,
- establishment of a closed hunting zone on Bouldin Island to provide greater sandhill crane foraging areas free from hunter disturbance,
- establishment of two additional closed hunting zones (one on each island) to provide waterfowl foraging and resting areas free from hunter disturbance, and
- establishment of a habitat island management oversight committee empowered to consult with DW and DFG to review monitoring data and develop recommendations for changes in habitat island management in future years as long as the primary goals of the HMP are not compromised.

Table 3H-4 summarizes the habitat-type acreages that would be created on the habitat islands under Alternative 1. Fields of corn rotated with wheat, mixed agriculture/seasonal wetlands, seasonal managed wetlands, and pasture/hay fields would be managed during fall and winter specifically to provide high-quality swan, goose, and duck foraging habitat. Seasonal ponds, some seasonal managed wetland, and small grain fields would be managed specifically to provide high-quality duck nesting and brood habitat.

Agricultural lands, seasonal wetland habitats, and herbaceous uplands would be managed during spring, summer, and fall to provide suitable Swainson's hawk habitat.

Habitats managed specifically to provide winter waterfowl foraging habitat and herbaceous uplands would also provide high-quality greater sandhill crane foraging habitat during winter. A portion of seasonal managed wetlands and cornfields on Bouldin Island would be managed specifically to provide crane roosting habitat and high-quality foraging habitat, respectively.

Riparian woodland and scrub habitats established to offset impacts on jurisdictional wetlands under Section 404 of the Clean Water Act (see Chapter 3G, "Vegetation and Wetlands") would provide habitat for a wide diversity of wildlife associated with riparian vegetation, including cavity-nesting species.

To offset the impact of hunting disturbance on foraging waterfowl and greater sandhill cranes, three closed hunting zones, totaling approximately 2,000 acres, would be established on the habitat islands.

Airstrip and Aircraft Restrictions. The Bouldin Island airstrip is located in the easternmost closed hunting zone on the island. Restrictions have been placed on use of the airstrip and aircraft on the habitat islands from September 1 through March 31 to reduce disturbance from airstrip and aircraft operations on waterfowl and greater sandhill cranes using closed hunting zones and other portions of the island. (Airstrip and aircraft use restrictions are detailed in Appendix G3, "Habitat Management Plan for the Delta Wetlands Habitat Islands".) Restrictions include limiting use of the airstrip and island overflights for farming and habitat management operations during the waterfowl hunting season to nonhunt days to prevent disturbance in closed hunting zones during periods of hunter disturbance.

Use of the airstrip and aircraft overflights of the islands for recreational and other uses is also restricted from September 1 through March 31. Restrictions include limiting use of the airstrip to 100 landings and takeoffs during the waterfowl season. Use of the airstrip for landings and takeoffs of fixed-winged aircraft, however, is permitted during hunt days. Consequently, waterfowl, greater sandhill cranes, and other wildlife using Bouldin Island on hunt days could be periodically disturbed by aircraft during periods of hunter disturbance.

Use by General Wildlife Species. Habitat availability and quality would be increased for most wildlife species groups on the habitat islands with implementation of Alternative 1. Table 3H-5 describes habitat island habitats that would be used by the major wildlife species groups on the islands. Details of general wildlife habitat management objectives, habitat descriptions, and habitat management prescriptions for habitat islands are presented in Appendix G3, "Habitat Management Plan for the Delta Wetlands Habitat Islands".

The acreages of riparian woodland and scrub, emergent marsh, and seasonal managed wetland habitats would increase substantially with project implementation. Creation of additional acreage of riparian and wetland habitats would primarily benefit piscivorous birds, wading birds, shorebirds, gulls and terns, and riparian and marsh birds.

Acreages of habitats used by upland and agricultural species would decrease with proposed project implementation. Implementation of management prescriptions for these habitats, however, would increase habitat quality above that associated with existing conditions.

Use by Waterfowl. A total of 8,220 acres of suitable agricultural, wetland, and upland waterfowl habitats will be created on the habitat islands (see Appendix G3, "Habitat Management Plan for the Delta Wetlands Habitat Islands", and Table 3H-4). Fields of corn rotated with wheat, mixed agriculture/seasonal wetland, seasonal managed wetland, and pasture/hay habitats will be managed specifically to provide high-quality waterfowl foraging habitat. Permanent lakes will provide large bodies of open water for use by waterfowl for resting.

Mixed agriculture/seasonal wetland, seasonal managed wetland, seasonal pond, emergent wetland, permanent lake, and herbaceous upland habitats will provide suitable nesting habitat for mallards, cinnamon teal, and other dabbling ducks. Seasonal pond habitats would be managed specifically to provide high-quality duck brood water. To encourage Canada goose and wood duck nesting, approximately 800 nesting platforms and boxes will also be constructed.

Levels of waterfowl hunting permitted on the habitat islands will be moderate relative to hunting levels on private duck clubs and state and federal waterfowl refuges (see Chapter 3J, "Recreation and Visual Resources"). To ensure wintering waterfowl use during the hunting season, three closed hunting zones have been established (two on Bouldin Island and one on Holland Tract). Approximately 22% of habitat island waterfowl habitats, including both permanent lakes on Bouldin Island, are within the closed hunting zones. Typically, between 15% and 50% of state and federal waterfowl refuges in the Central Valley are designated as closed

hunting zones. To reduce human disturbances to waterfowl using closed hunting zones, only spaced-blind hunting, which restricts hunter movement, would be allowed in nearly all areas adjacent to closed hunting zones; free-roam hunting would be allowed on a small area adjacent to the northeast corner of the Holland Tract closed zone.

Use by Upland Game. Approximately 7,926 acres of corn, wheat, small grain, mixed agriculture/seasonal wetland, seasonal managed wetland, pasture/hay, riparian woodland and scrub, and herbaceous upland habitats on the habitat islands will provide foraging and nesting habitat and escape cover for ring-necked pheasants, mourning doves, and quail (Table 3H-4). During fall and winter, up to 3,688 acres of corn, wheat, mixed agriculture/ seasonal wetland, seasonal managed wetland, and pasture/hay habitats would be unsuitable upland game habitat as a result of shallow flooding to attract waterfowl.

Use by Special-Status Species

Swainson's Hawk. A total of 7,539 acres of suitable spring, summer, and fall foraging habitat for Swainson's hawks of poor, fair, and good quality will be developed on the habitat islands (see Appendix G3, "Habitat Management Plan for the Delta Wetlands Habitat Islands"). Suitable Swainson's hawk foraging habitat will include cornfields, wheat fields, and small grain fields, mixed agriculture/ seasonal wetlands, seasonal managed wetlands, pasture/hay fields, and herbaceous uplands. Portions of nonagricultural habitats would also be mowed to enhance foraging habitat quality.

Approximately 390 acres of existing and created riparian woodland and scrub habitats would provide suitable Swainson's hawk nesting habitat (see Appendix G5, "Summary of Jurisdictional Wetland Impacts and Mitigation").

Greater Sandhill Crane. A total of 7,673 acres of suitable winter foraging habitat for greater sandhill crane of poor, fair, and good quality would be developed on the habitat islands. Suitable habitat would include corn, wheat, and small grain fields; mixed agriculture/seasonal wetlands; seasonal managed wetlands; seasonal ponds; pasture/hay fields; and herbaceous uplands (see Appendix G5).

Three closed hunting zones, totaling 2,008 acres, to be established on the habitat islands (two on Bouldin Island and one on Holland Tract), would provide greater sandhill crane foraging areas free from hunter disturbance during hunt days. A portion of seasonal managed wetlands in one Bouldin Island closed hunting zone would be managed specifically to provide crane roosting habitat. A portion of cornfields near wetlands managed as roosts would be harvested in a manner that would provide optimum crane foraging habitat (see Appendix G3 for a description of the purposes for closed hunting zones on the habitat islands).

Other Special-Status Species. Twenty-two other special-status species occur or could occur on the habitat islands under Alternative 1. Table 3H-6 summarizes habitat island habitats that could be used by these species with implementation of the DW project HMP.

Summary of Project Impacts and Recommended Mitigation Measures

Table 3H-7 summarizes changes in habitat types and acreages from existing conditions to conditions that would occur under Alternative 1.

Impact H-1: Loss of Upland Habitats. Loss of herbaceous upland, exotic marsh, and agricultural habitats on the reservoir islands would reduce the acreage of habitat for western meadowlarks, white-crowned sparrows, and other regionally abundant song birds. Existing upland and agricultural habitats that also provide low to moderate forage value for several breeding and wintering raptor species would also be reduced. As part of the proposed project, implementation of the HMP detailed in Appendix G3, "Habitat Management Plan for the Delta Wetlands Habitat Islands", would offset impacts of reservoir island water storage operations under Alternative 1 by creating fewer, but higher quality, upland habitats. Therefore, this impact is considered less than significant.

Mitigation. No mitigation is required.

Impact H-2: Increase in Suitable Wetland Habitats for Nongame Water and Wading Birds. Approximately 3,750 acres of additional wetland habitat would be created under Alternative 1 with implementation of the HMP. Seasonal wetlands, emergent marshes, and lakes that would be created on the habitat islands would provide foraging or nesting habitat, or both, for resident and migrant grebes, shorebirds, egrets, herons, gulls, terns, and other wetland-associated birds in the Delta region. During water storage periods, the reservoir islands would also provide foraging and resting habitat for grebes, gulls, terns, cormorants, and other water birds. Although not required to offset impacts, management of the reservoir islands for shallow-water wetlands would provide habitat values for shorebirds, wading birds, and water birds similar to, but of lower quality than, those

described for the habitat islands. This impact is considered beneficial.

Mitigation. No mitigation is required.

Impact H-3: Loss of Foraging Habitats for Wintering Waterfowl. Wintering waterfowl are dependent on agricultural crops, primarily corn and wheat, for forage in the Delta. Water storage operations on the reservoir islands would decrease the amount of agricultural crops on the reservoir islands. However, implementation of Alternative 1 would include intensive management of corn, wheat, mixed agriculture/seasonal wetland, seasonal managed wetland, and pasture/hay habitats on habitat islands specifically to provide high-quality waterfowl forage values. Small grain fields, seasonal ponds, permanent lakes, emergent marshes, and herbaceous uplands would also provide foraging areas for wintering waterfowl on the habitat islands.

Wetland waterfowl foraging habitat would also be created on the reservoir islands during years and seasons in which islands could be managed as shallow-water wetlands. How frequently and for how long islands could be managed as shallow-water wetlands, however, cannot be predicted. The quality of foraging habitat on the reservoir islands would also vary among years when shallow-water wetlands could be created, depending on the types and density of vegetation that becomes reestablished on the reservoir islands following water storage periods.

Results of the modified HEP analysis performed by the HMP team indicate that implementation of the HMP under Alternative 1 would offset impacts of project operations on low- to moderate-quality wintering waterfowl foraging habitats through creation of high-quality foraging habitats on the habitat islands. Therefore, this impact is considered less than significant.

Mitigation. No mitigation is required.

Impact H-4: Increase in Suitable Breeding Habitats for Waterfowl. Few dabbling ducks and no geese currently successfully nest on the DW project islands. The primary factors limiting duck production are the availability of nesting habitat and availability of suitable brood water for ducklings. Implementation of the HMP under Alternative 1 would include establishment of duck nesting habitats, creation of waterfowl brood ponds, and construction of wood duck nest boxes and goose nesting platforms on the habitat islands. Therefore, this impact is considered beneficial.

Mitigation. No mitigation is required.

Impact H-5: Loss of Habitats for Upland Game Species. Implementation of Alternative 1 would, as a result of habitat loss associated with operation of the reservoir islands, cause a substantial decline of populations of ring-necked pheasant, the most common upland game species. Implementation of the HMP would provide higher quality habitats on the habitat islands than under existing conditions. Portions of these habitats would be unavailable to pheasants during fall and winter flood periods; however, habitat suitability would be improved during the breeding season, when agricultural lands typically provide unsuitable habitat. Few pheasant hunters currently hunt on the DW project islands and the hunting program under the HMP is expected to focus on waterfowl hunting and to have less emphasis on hunting for upland game species, including pheasant. (See Chapter 3J, "Recreation and Visual Resources", for more details on hunting.)

Other upland game species (mourning dove, California quail, and desert cottontail) are currently present in low numbers and primarily occupy island levees. Upland game birds would use the reservoir islands during non-storage, shallow-storage, and shallow-water wetland periods. Desert cottontail may become extirpated from Bacon Island (cottontails are not found on Webb Tract [Swanson pers. comm.]) because maximum storage events would completely inundate island interiors, except for riprapped portions of upper levee slopes. Mourning dove and California quail would benefit from the establishment of 154 additional acres of riparian woodland and scrub habitats on the habitat islands. Therefore, this impact is considered less than significant.

Mitigation. No mitigation is required.

Impact H-6: Increase in Suitable Foraging Habitat for Greater Sandhill Crane. Greater sandhill cranes forage in corn and grain fields, wetlands, pastures, and herbaceous uplands. Implementation of the HMP under Alternative 1 would include replacing the acreage lost as a result of water storage operations of the reservoir islands and creating approximately 645 more acres of greater sandhill crane foraging habitat than required by DFG and the HMP team to compensate for habitat losses (see Appendix H4, "California Endangered Species Act Biological Assessment: Impacts of the Delta Wetlands Project on Swainson's Hawk and Greater Sandhill Crane"). Therefore, this impact is considered beneficial.

Mitigation. No mitigation is required.

Impact H-7: Increase in Suitable Roosting Habitat for Greater Sandhill Crane. Greater sandhill cranes currently do not roost on the DW project islands. Suitable roosting sites are a key habitat requirement for wintering greater sandhill cranes, and such sites are limited in the Delta (see Appendix H4). Implementation of the HMP under Alternative 1 would include creation of wetlands managed specifically to provide roosting habitat for greater sandhill cranes. The value of crane foraging habitats that would be created on the habitat islands would also be enhanced with development of roosting habitat because cranes typically forage near roosts. Therefore, this impact is considered beneficial.

Mitigation. No mitigation is required.

Impact H-8: Increase in Suitable Foraging Habitat for Swainson's Hawk. Implementation of Alternative 1 would result in the loss of 10,048 acres of suitable foraging habitat for Swainson's hawk. DFG guidelines (DFG 1993) were used to determine compensation habitat acreage that would be required to offset project impacts on Swainson's hawk foraging habitat (see Appendix H4). Implementation of the HMP under Alternative 1 would result in replacement of the acreage lost from water storage operations of the reservoir islands and creation of approximately 831 more acres of Swainson's hawk foraging habitat than are required by DFG to compensate for habitat losses. Therefore, this impact is considered beneficial.

Mitigation. No mitigation is required.

Impact H-9: Increase in Suitable Nesting Habitat for Swainson's Hawk. Implementation of the HMP under Alternative 1 would result in the establishment of approximately 154 additional acres of riparian woodland and scrub habitats. Mature cottonwood and willow trees would provide suitable Swainson's hawk nest sites. Therefore, this impact is considered beneficial.

Mitigation. No mitigation is required.

Impact H-10: Loss of Foraging Habitat for Aleutian Canada Goose. Aleutian Canada geese could occur irregularly on all four DW project islands because agricultural and herbaceous habitats are suitable, but the species has been observed only on Bouldin Island and generally uses traditional areas elsewhere in the Delta. Therefore, loss of suitable habitat caused by water storage on reservoir islands would not adversely affect the species. Implementation of the HMP under Alternative 1 would offset any possible loss of Aleutian Canada goose habitat on the reservoir islands through creation of suitable habitat on the habitat islands. Therefore, this impact is considered less than significant.

Mitigation. No mitigation is required.

Impact H-11: Increase in Suitable Nesting Habitat for Northern Harrier. Harriers were observed during the breeding season on Webb and Holland Tracts and may have nested on those islands. Breeding habitat in the past consisted of approximately 2,400 acres of fallow areas that had not been reclaimed for agriculture following past levee breaks on Webb and Holland Tracts. Although much of this habitat may have been eliminated on the two islands by renewed agricultural cultivation, it is assumed for this analysis that implementation of Alternative 1 would eliminate these 2,400 acres of habitat.

Implementation of the HMP under Alternative 1 would include establishment of 3,588 acres of seasonal managed wetlands, seasonal ponds, pasture/ hay fields, emergent marshes, and herbaceous uplands that would be suitable nesting habitat for northern harrier (Table 3H-4). Establishment of these habitats would replace the acreage lost as a result of water storage operations on the reservoir islands and provide 1,188 more acres of suitable nesting habitat for this species than under existing conditions. Therefore, this impact is considered beneficial.

Mitigation. No mitigation is required.

Impact H-12: *Loss of* Wintering Habitat for Tricolored Blackbird. Tricolored blackbirds typically forage in marshes and agricultural wetlands and could occur on all four islands during winter, although none were observed during fields surveys. Wintering habitat is abundant in the Delta and Central Valley and is not considered limiting to the species (Beedy pers. comm.). Nonetheless, creation and management of mixed agriculture/seasonal wetland, seasonal managed wetland, seasonal pond, pasture/hay, emergent marsh, and permanent lake habitats on the habitat islands with implementation of the HMP under Alternative 1 would ensure that any possible impacts on wintering tricolored blackbirds would be offset. Therefore, this impact is considered less than significant.

Mitigation. No mitigation is required.

Impact H-13: Increase in Suitable Nesting Habitat for Tricolored Blackbird. None of the four DW project islands supports nesting colonies of tricolored blackbirds. Also, none of the islands is close enough to suitable or historically used nesting areas to be used for foraging during the nesting season. Most tricolored blackbird colonies are established in tule- and

cattail-dominated freshwater marshes (Beedy et al. 1991). Implementation of the HMP would include creation of approximately 175 more acres of emergent freshwater marsh than currently exist on project islands that would be suitable tricolored blackbird nesting habitat. Therefore, this impact is considered beneficial.

Mitigation. No mitigation is required.

Impact H-14: Increase in Suitable Habitats for Special-Status Wildlife Species. Project impacts were not assessed for most special-status species that could occur on the DW project islands (Table 3H-6) because these species currently are not known to be present or are found only irregularly on the islands. Creation and management of agricultural, upland, wetland, and riparian habitats for wildlife with implementation of the HMP and operation of the reservoir islands under Alternative 1, however, would increase the quantity and quality of suitable habitat for 19 special-status species. (Project impacts on the Aleutian Canada goose, northern harrier, and tricolored blackbird, which are also listed in Table 3H-6, are described above.) Therefore, this impact is considered beneficial.

Mitigation. No mitigation is required.

Impact H-15: Temporary Construction Impacts on State-Listed Species. Construction activities associated with refurbishing and enlarging levees, installing project infrastructure, and grading to establish habitat island habitats could result in temporary impacts on state-listed species. Construction activities could affect nesting Swainson's hawks through disturbance or loss of occupied nest trees, disturb roosting greater sandhill cranes, or disturb California black rails nesting in Delta channels adjacent to DW project islands.

Implementation of the construction implementation plan identified in the HMP would offset temporary construction impacts on habitat islands. Temporary construction impacts on state-listed species, however, could occur during construction on the reservoir islands. Therefore, this impact is considered significant.

Implementing Mitigation Measure H-1 would reduce impact H-15 to a less-than-significant level.

Mitigation Measure H-1: Develop and Implement a Construction Mitigation Plan for the Reservoir Islands. DW shall develop a construction mitigation plan for the reservoir islands following development of detailed project construction schedules, specifications, and plan drawings for construction of project infrastructure, pumps and siphons, enlarged levees, and recreation and other facilities. The plan will be submitted to SWRCB and DFG for approval. Disagreements between DW and DFG during the plan approval process may be submitted to the SWRCB Chief of the Division of Water Rights for resolution.

The construction mitigation and monitoring plan will identify methods to avoid impacts on nesting Swainson's hawks, roosting greater sandhill cranes, and nesting California black rails. These methods shall include conducting preconstruction surveys to locate nesting and roosting sites of these species and may include measures such as avoiding construction during sensitive use periods.

Elements of the plan will identify:

- preconstruction survey protocols to locate Swainson's hawk nest sites and greater sandhill crane roosts on reservoir islands and nesting California black rails on the water side of perimeter levees;
- measures that would be instituted to avoid affecting state-listed wildlife species, including restriction of construction activities to areas at least 200 yards from nesting California black rails;
- construction monitoring methods and schedule to be implemented to ensure compliance with the construction mitigation plan; and
- potential remedial measures to compensate for impacts incurred during construction that are not identified in the HMP.

Following construction, DW shall submit a report describing success of construction impact avoidance measures to the SWRCB Chief of the Division of Water Rights and DFG.

Impact H-16: Disturbance to Greater Sandhill Cranes and Wintering Waterfowl from Aircraft Operations. The Bouldin Island airstrip may be used to ferry hunters to the island or for other recreational uses. Up to 100 takeoffs and landings of fixed-wing aircraft related to such uses are permitted on hunt and nonhunt days during waterfowl hunting season. Use of the airstrip on hunt days would be allowed only between 12:00 p.m. and 2:00 p.m. The airstrip is located in the east Bouldin Island closed hunting zone. Closed hunting zones were established on the habitat islands to provide resting and foraging areas for greater sandhill cranes and wintering waterfowl that would be free from hunter disturbance on

days when other portions of the habitat islands are hunted. Use of the airstrip on hunt days therefore could result in additional disturbance of these species on hunt days and could reduce habitat values provided by the closed hunting zone. Therefore, this impact is considered significant.

Implementing Mitigation Measure H-2 would reduce Impact H-16 to a less-than-significant level.

Mitigation Measure H-2: Monitor Effects of Aircraft Flights on Greater Sandhill Cranes and Wintering Waterfowl and Implement Actions to Reduce Aircraft Disturbances of Wildlife. DW shall develop a monitoring program in consultation with DFG and the HMAC and implement the program to determine whether airstrip use on hunt days has a deleterious effect on greater sandhill cranes or waterfowl. The plan shall be submitted to SWRCB's Chief of the Division of Water Rights within one year of issuance of project operation permits.

The following will be the major elements of the monitoring plan:

- criteria for evaluating monitoring data that would be used to determine whether use of the airstrip on hunt days is having a significant impact on greater sandhill cranes and waterfowl,
- criteria for determining appropriate mitigation requirements for offsetting significant impacts based on the level of impact airstrip use has on these species,
- a detailed description of monitoring protocols, and
- a monitoring schedule that estimates when data would be sufficient to determine whether airstrip use on hunt days has significant impacts on greater sandhill cranes or waterfowl.

If, based on monitoring results, airstrip use on hunt days is found to have a significant impact on greater sandhill cranes or waterfowl, DFG, in consultation with the HMAC, may recommend to SWRCB's Chief of the Division of Water Rights that airstrip use be modified to ensure that the goals for establishment of the closed hunting zone are met. Depending on the level of impact, recommendations could include closing hunting on Bouldin Island during the landing and takeoff period, restricting the number of flights permitted per day, changing the landing and takeoff period to reduce impacts, or closing the use of the airstrip on hunt days. Conversely, if monitoring indicates that there is no significant impact on greater sandhill cranes or wintering waterfowl, DFG, in consultation with the HMAC, could recommend that the proposed initial aircraft use restrictions remain in place or be reduced.

Impact H-17: Potential for Increased Incidence of Waterfowl Diseases. Diseases kill substantial numbers of waterfowl in the Central Valley every year (Tiche 1988). Habitat management changes under Alternative 1 could increase the incidence of disease if habitat conditions are created that favor disease organisms or concentrate birds so that diseases were more easily transmitted. Two important diseases that affect waterfowl in the Delta are botulism and avian cholera. Expected habitat conditions and bird use on the DW islands with implementation of Alternative 1 were analyzed to assess the potential for increases in waterfowl mortality resulting from disease in the Delta.

Botulism develops in waters subject to anaerobic conditions, generally when rotting vegetation depletes oxygen from water. These conditions occur most often in warm, shallow waters and especially in areas with alkaline soils. In general, waterfowl mortality resulting from botulism is minimal in the Delta (Fredrickson et al. 1988). However, the proposed deep flooding of abundant wetland vegetation on the reservoir islands raises concerns regarding botulism potential.

Botulism is not likely to become a problem on the reservoir islands for several reasons. During November-May water storage periods, temperatures are low enough for the water to remain highly oxygenated and vegetation decomposition to occur slowly. June and July are windy months in the Delta and they are the warmest months during water storage periods. Winds would aerate the water, thereby reducing the likelihood that the anaerobic conditions necessary for botulism to develop would occur during this period (Miller pers. comm.). During periods when reservoir islands are managed as shallow-water wetlands, DW would circulate water through wetlands, reducing the likelihood that anaerobic conditions would develop, and would have the capability to drain wetlands rapidly in case an outbreak of botulism were to occur.

Peat soils exposed during water storage drawdown periods on the reservoir islands would quickly dry out and absorb oxygen; this absorption would prevent creation of anaerobic conditions during periods when water is diverted onto the islands. During wetland management periods on both the reservoir and habitat islands, circulation of water through wetland cells would oxygenate the water and reduce the potential for development of

botulism (Fredrickson et al. 1988). The incidence of botulism would be expected to be minimal under anticipated project conditions.

Avian cholera is a contagious disease that kills substantial numbers of waterfowl in the Delta annually (Tiche 1988, Gifford pers. comm.). Cholera is more likely to spread when birds concentrate in high numbers and densities in shallow-water areas. Thus, actions that change waterfowl distribution and density patterns may affect the incidence of cholera.

Waterfowl on the reservoir islands would be distributed during shallow-water wetland periods over a large acreage of shallowly flooded area. Hunting during these periods would periodically disturb birds and prevent them from congregating in large numbers. Waterfowl would not make intensive, concentrated use of the deep-water habitats during water storage periods; moderate use by the canvasback and other diving ducks would be expected.

Cholera could become a problem in permanent lakes on Bouldin Island with implementation of the HMP. The risk would be no greater, however, than that currently existing at blowout ponds on Webb and Holland Tracts or in shallow pools in agricultural lands created by the accumulation of rainwater or seepage.

Cholera could also become a problem in cornfields and wheat fields, mixed agriculture/seasonal wetlands, and seasonal managed wetlands on the habitat islands because large numbers of birds would be attracted to the abundant and concentrated foods. Hunting would disturb waterfowl species in hunting zones during October-January and prevent them from concentrating in large numbers on days when hunting is permitted. Large numbers of waterfowl, however, would be expected to concentrate in closed hunting zones.

Waterfowl habitat conditions created on the habitat islands and, during some periods, on the reservoir islands under Alternative 1 would concentrate waterfowl in numbers that could be large enough to increase the incidence of avian cholera. Therefore, this impact is considered significant.

Implementing Mitigation Measure H-3 would reduce Impact H-17 to a less-than-significant level.

Mitigation Measure H-3: Monitor Waterfowl Populations for Incidence of Disease and Implement Actions to Reduce Waterfowl Mortality. DW shall retain a qualified biologist to monitor waterfowl use areas on the DW project islands to locate incidences of waterfowl disease mortalities. DW, in cooperation with DFG and USFWS, shall develop management strategies to be employed in the event of disease outbreaks. On identification of a disease outbreak, DW shall notify DFG and, in cooperation with DFG biologists, implement management strategies to reduce waterfowl mortality. Management actions may include removing carcasses from the DW islands, hazing waterfowl from the islands, or draining waterfowl habitats.

Management strategies will include descriptions of:

- methods used to monitor waterfowl to detect disease outbreaks,
- protocols for determining when and what types of management actions to reduce the incidence of disease would be implemented,
- methods for collecting carcasses and removing them from affected areas,
- potential locations and methods for disposal of collected carcasses, and
- methods to haze waterfowl from reservoir islands.

Impact H-18: Potential Disruption of Waterfowl Use as a Result of Increased Hunting. Most species of waterfowl quickly learn to identify and avoid hunted areas (Bellrose 1976, Sacramento Valley Waterfowl Habitat Management Committee n.d.). Hunting disturbance can reduce waterfowl use of foraging areas to levels below the areas' potential as determined by foraging habitat quality. During their searches for feeding and resting areas, waterfowl also quickly recognize and use areas that are not being hunted and will use hunting areas that are "rested" regularly from shooting activity. Existing levels of waterfowl hunting are low on the DW project islands and do not substantially affect use of the islands by waterfowl.

No waterfowl hunting restrictions are proposed by DW or are required to offset project impacts on the reservoir islands. DW, however, may limit hunting on the reservoir islands to Wednesdays, Saturdays, and Sundays during the hunting season to preserve hunting quality and reduce bird disturbance. On shooting days, birds would disperse to unhunted portions of the islands or other protected areas. Many birds would likely congregate in closed hunting zones on the habitat islands, Franks Tract, or other unhunted areas elsewhere in the Delta. If DW allows hunting only on specified days, the

hunting schedule would permit waterfowl to return to feed on the project islands on nonshooting days.

DW's proposed hunting program for the habitat islands is described in the HMP (see Appendix G3, "Habitat Management Plan for the Delta Wetlands Habitat Islands"). The hunting program would reduce hunter disturbance to levels that would not substantially disturb waterfowl; elements include allowing hunting only 3 days each week (DW would also select 2 additional hunting days during waterfowl season), establishing over 2,000 acres of closed hunting zones to provide undisturbed waterfowl use areas, restricting the numbers of hunters permitted on islands, and permitting only spaced-blind hunting adjacent to closed hunting zones to reduce disturbance to birds in closed zones. Potential impacts of the hunting program under Alternative 1 were incorporated into the modified HEP analysis conducted for HMP development. The analysis indicated that implementation of the HMP and the hunting program would ensure that waterfowl would use the habitat islands at levels that would offset impacts of Alternative 1 on wintering waterfowl. Therefore, this impact is considered less than significant.

Mitigation. No mitigation is required.

Impact H-19: Potential Disruption of Greater Sandhill Crane Use of the Habitat Islands as a Result of Increased Hunting. Greater sandhill cranes react to hunting disturbance in much the same way as described for waterfowl under Impact H-18 (Schlorff pers. comm.). Little or no suitable foraging habitat for greater sandhill cranes would exist on the reservoir islands and, therefore, hunting on these islands would not affect greater sandhill crane foraging activities. Waterfowl and upland game hunting would occur on the habitat islands under Alternative 1. Implementation of the HMP, however, would restrict the number of hunting days per week and the number of hunters. One 810-acre closed hunting zone would be established on Bouldin Island that would offset the impact of hunting on crane use of foraging habitat. Two other closed hunting zones, totaling 1,198 acres, would be established to enhance waterfowl use of the habitat islands and would also provide large, undisturbed areas of crane foraging and loafing habitat. This impact is therefore considered less than significant.

Mitigation. No mitigation is required.

Impact H-20: Increase in Waterfowl Harvest Mortality. Existing levels of hunting on the DW project islands and numbers of waterfowl harvested in the Delta are low. Because of this low harvest rate, the Delta provides an unofficial sanctuary area, which has been suggested to be important to maintaining populations of waterfowl, especially the white-fronted goose (Fleskes pers. comm.). The population of white-fronted goose declined in the 1970s but has recovered in recent years (Deuel pers. comm.). A substantial proportion of the entire population winters in the Delta region.

Existing harvest rates on the DW project islands, as derived from known hunting use, are low (Table 3H-8). Implementation of Alternative 1 would result in a substantial increase in waterfowl harvest over existing conditions on the four DW project islands (Table 3H-8). The harvest would increase because more hunters would be present and larger waterfowl populations would be attracted to the islands. Projected harvest levels on the DW project islands would represent 1.2% (approximately 1,612 birds) of the average statewide goose harvest (138,500 birds) and 1.6% (approximately 24,195 birds) of the average statewide duck harvest (1,493,500 birds) during 1984-1987 (Deuel pers. comm.). This estimated harvest level also reflects addition of hunters who would be attracted to the DW project islands but currently hunt other areas. Harvest increases projected under Alternative 1, however, are expected to be partially offset by increased duck production that would occur on the habitat islands with implementation of the HMP. Therefore, this impact is considered less than significant.

Mitigation. No mitigation is required.

Impact H-21: Potential Changes in Local and Regional Waterfowl Use Patterns. Under Alternative 1, the quality of foraging habitat for swans and white-fronted geese on the habitat islands would be similar to or greater than habitat quality provided on all four of the DW project islands under existing conditions. Duck use of all the DW project islands, however, is expected to be substantially greater under Alternative 1. This level of increase is not likely to cause a noticeable change in waterfowl populations and harvest in other parts of the Delta, in the Central Valley, or at Suisun Marsh because the DW project islands would be hunted and agricultural and seasonal wetland habitats would be flooded on staggered schedules through winter, thereby reducing habitat availability in some periods. Therefore, this impact is considered less than significant.

Mitigation. No mitigation is required.

Impact H-22: Potential Effects on Wildlife and Wildlife Habitats Resulting from Delta Outflow Changes. Compliance with existing water quality objectives and other requirements would ensure that changes in Delta outflow do not cause salinity changes that would be detrimental to the management of wetlands for wildlife

(Wernette pers. comm.) (see Chapters 3A, "Water Supply and Water Project Operations"; 3B, "Hydrodynamics"; and 3C, "Water Quality"). No substantial impacts on wildlife habitats or populations are expected to occur. Therefore, this impact is considered less than significant.

Mitigation. No mitigation is required.

IMPACTS AND MITIGATION MEASURES OF ALTERNATIVE 2

The impacts and mitigation measures of this alternative are the same as those of Alternative 1.

IMPACTS AND MITIGATION MEASURES OF ALTERNATIVE 3

Alternative 3 involves storage of water on Bacon Island, Webb Tract, Bouldin Island south of SR 12, and Holland Tract, with secondary uses for wildlife habitat and recreation. Reservoir islands would be managed in fall, winter, and spring as shallow-water wetlands during some nonstorage periods. The portion of Bouldin Island north of SR 12 would be managed as the NBHA. However, in contrast to their use under Alternatives 1 and 2, Bouldin Island and Holland Tract would not be devoted entirely to providing wildlife habitat under Alternative 3.

Changes in Wildlife Habitat Conditions and Use

Bacon Island, Webb Tract, Bouldin Island South of SR 12, and Holland Tract

All wildlife habitat conditions on the reservoir islands under Alternative 3 would be similar to conditions described above under "Impacts and Mitigation Measures of Alternative 1", except that the frequency of these conditions would differ (see Appendix G4, "Prediction of Vegetation on the Delta Wetlands Reservoir Islands").

Impacts on wildlife under Alternative 3 on the reservoir islands would be the same as those described above for reservoir islands under "Impacts and Mitigation Measures of Alternative 1". The magnitudes of beneficial and adverse impacts, however, would be greater because the land area affected by water storage would be increased by approximately 9,327 acres. Table 3H-9 summarizes the acreages of existing foraging habitats for Swainson's hawk, greater sandhill crane, and wintering waterfowl and riparian woodland and scrub habitats that would be affected by implementation of Alternative 3.

North Bouldin Habitat Area

The portion of Bouldin Island north of SR 12 would be managed as the NBHA. Approximately 50 acres of perennial ponds, 330 acres of seasonal managed wetlands, 170 acres of corn, 200 acres of riparian woodland, and 125 acres of herbaceous uplands would be established and managed for wildlife in the NBHA (see Appendix G2, "Prediction of Vegetation on the Delta Wetlands Reservoir Islands").

Wildlife habitat conditions associated with each of the NBHA habitats are the same as those described above for habitat island habitats under "Impacts and Mitigation Measures of Alternative 1". Detailed descriptions of how these habitats would be managed and the wildlife values they provide are presented in Appendix G3, "Habitat Management Plan for the Delta Wetlands Habitat Islands".

Impacts on wildlife resulting from development of the NBHA would be similar to those described above for the habitat islands under "Impacts and Mitigation Measures of Alternative 1" for each of the habitat types that would be established (see Appendix G3).

Summary of Project Impacts and Recommended Mitigation Measures

Table 3H-10 compares changes in habitat types and acreages under existing conditions and conditions that would occur under Alternative 3.

Impact H-23: Loss of Upland Habitats. Water storage operations on the reservoir islands under Alternative 3 would result in the loss of approximately 17,529 acres of herbaceous upland, exotic marsh, and agricultural habitats (Table 3H-9). These habitats provide foraging areas for wintering raptors and resident and migrant songbirds associated with herbaceous and agricultural habitats. Therefore, this impact is considered significant.

Implementing Mitigation Measure H-4 would reduce Impact H-23 to a less-than-significant level.

Mitigation Measure H-4: Develop and Implement an Offsite Wildlife Habitat Mitigation Plan. DW, in consultation with SWRCB, the Corps, DFG, and USFWS, shall implement an offsite mitigation plan for mitigating impacts on wildlife habitat. Once DW has identified offsite mitigation areas, an HMP team, composed of representatives approved of by SWRCB, shall be established to develop the offsite mitigation plan. No diversion shall be permitted until California Endangered Species Act consultations have been completed; a no-jeopardy opinion has been issued by DFG; and a mitigation plan and mitigation implementation schedule have been approved by SWRCB's Chief of the Division of Water Rights.

Impact H-24: Loss of Foraging Habitats for Wintering Waterfowl. Implementation of Alternative 3 would result in the loss of approximately 19,388 acres of low- to moderate-quality foraging habitats for wintering waterfowl (Table 3H-9). Therefore, this impact is considered significant.

Implementing Mitigation Measure H-4 would reduce Impact H-24 to a less-than-significant level.

Mitigation Measure H-4: Develop and Implement an Offsite Wildlife Habitat Mitigation Plan. This mitigation measure is described above.

Impact H-25: Increase in Suitable Breeding Habitats for Waterfowl. Development of the NBHA under Alternative 3 would include establishment of duck nesting habitats, creation of waterfowl brood ponds, and construction of wood duck nest boxes and goose nesting platforms. These actions would increase the suitability of the DW project islands as waterfowl breeding habitat. Therefore, this impact is considered beneficial.

Mitigation. No mitigation is required.

Impact H-26: Loss of Habitats for Upland Game Species. The impacts of water storage operations on upland game species and their habitats are described above under "Impacts and Mitigation Measures of Alternative 1". Implementation of Alternative 3 would result in the loss of 18,678 acres of suitable upland game habitat (i.e., agricultural habitats, riparian woodland and scrub habitats, exotic marshes, and herbaceous uplands). This impact is considered significant.

Implementing Mitigation Measure H-4 would reduce Impact H-26 to a less-than-significant level.

Mitigation Measure H-4: Develop and Implement an Offsite Wildlife Habitat Management Plan. This mitigation measure is described above.

Impact H-27: Loss of Foraging Habitat for Greater Sandhill Crane. Implementation of Alternative 3 would result in the loss of approximately 14,220 acres of foraging habitat for greater sandhill crane (Table 3H-9). This impact is considered significant.

Implementing Mitigation Measure H-4 would reduce Impact H-27 to a less-than-significant level.

Mitigation Measure H-4: Develop and Implement an Offsite Wildlife Habitat Management Plan. This mitigation measure is described above.

Impact H-28: Loss of Foraging Habitat for Swainson's Hawk. Implementation of Alternative 3 would result in the loss of approximately 17,529 acres of foraging habitat for Swainson's hawk (Table 3H-9). This impact is considered significant.

Implementing Mitigation Measure H-4 would reduce Impact H-28 to a less-than-significant level.

Mitigation Measure H-4: Develop and Implement an Offsite Wildlife Habitat Mitigation Plan. This mitigation measure is described above.

Impact H-29: Loss of Foraging Habitat for Aleutian Canada Goose. This impact on the reservoir islands is described above under Impact H-10. This impact is considered less than significant.

Mitigation. No mitigation is required.

Impact H-30: Loss of Nesting Habitat for Northern Harrier. Implementation of Alternative 3 would result in the loss of nearly 2,400 acres of potential nesting habitat for northern harrier on Webb and Holland Tracts. The significance of the loss of this habitat is uncertain for several reasons. First, the habitat loss represents a small proportion of the available habitat in the Delta region. Second, high-quality nesting habitat created on the NBHA would partially offset losses elsewhere on the DW project islands. Third, acreages of suitable nesting habitat in the western Delta area are expected to increase as lands are taken out of agricultural production to prevent continued land subsidence (DWR 1988, 1990a). Finally, the harrier is relatively abundant regionally; harrier densities recorded in USFWS breeding bird surveys in the Central Valley are the highest in the United States and Canada (Robbins et al. 1986). Although habitat on Webb and Holland Tracts may not be

occupied, implementing Alternative 3 could result in the loss of potential nesting habitat. Therefore, this impact is considered significant.

Implementing Mitigation Measure H-4 would reduce Impact H-30 to a less-than-significant level.

Mitigation Measure H-4: Develop and Implement an Offsite Wildlife Habitat Mitigation Plan. This mitigation measure is described above.

Impact H-31: Loss of Wintering Habitat for Tricolored Blackbird. This impact is described above under Impact H-12. This impact is considered less than significant.

Mitigation. No mitigation is required.

Impact H-32: Temporary Construction Impacts on State-Listed Species. This impact is described above under Impact H-15. This impact is considered significant. Implementing Mitigation Measure H-1 would reduce Impact H-32 to a less-than-significant level.

Mitigation Measure H-1: Develop and Implement a Construction Mitigation Plan for the Reservoir Islands. This mitigation measure is described above under "Impacts of Mitigation Measures of Alternative 1".

Impact H-33: Potential for Increased Incidence of Waterfowl Diseases. This impact is described above under Impact H-17. This impact is considered significant.

Implementing Mitigation Measure H-3 would reduce Impact H-33 to a less-than-significant level.

Mitigation Measure H-3: Monitor Waterfowl Populations for Incidence of Disease and Implement Actions to Reduce Waterfowl Mortality. This mitigation measure is described above under "Impacts and Mitigation Measures of Alternative 1".

Impact H-34: Potential Disruption of Waterfowl Use as a Result of Increased Hunting. This impact on reservoir islands is described above under Impact H-18. This impact is considered less than significant.

Mitigation. No mitigation is required.

Impact H-35: Increase in Waterfowl Harvest Mortality. This impact is described above under Impact H-20. Waterfowl harvest would be approximately 65% of the harvest predicted under Alternative 1. This impact is considered less than significant.

Mitigation. No mitigation is required.

Impact H-36: Potential Changes in Local and Regional Waterfowl Use Patterns. This impact is described above under Impact H-21. This impact is considered less than significant.

Mitigation. No mitigation is required.

Impact H-37: Potential Effects on Wildlife and Wildlife Habitats Resulting from Delta Outflow Changes. This impact is described above under Impact H-22. This impact is considered less than significant.

Mitigation. No mitigation is required.

IMPACTS AND MITIGATION MEASURES OF THE NO-PROJECT ALTERNATIVE

The project applicant would not be required to implement mitigation measures if the No-Project Alternative were selected by the lead agencies. However, mitigation measures are presented for impacts of the No-Project Alternative to provide information to the reviewing agencies regarding the measures that would reduce impacts if the project applicant implemented a project that required no federal or state agency approvals. This information would allow the reviewing agencies to make a more realistic comparison of the DW project alternatives, including implementation of recommended mitigation measures, with the No-Project Alternative.

Changes in Wildlife Habitat Conditions and Use

Under Section 404(f)(1) of the Clean Water Act, normal farming activities, such as plowing, seeding, cultivating, and maintaining drainage ditches, are exempt from Section 404 permit requirements as long as surface materials are not redistributed by blading or grading to fill a Section 404 jurisdictional wetland area. The No-Project Alternative is thus limited to those farming activities to increase cropping intensity that could be implemented without a Section 404 permit.

Implementation of the No-Project Alternative would involve intensive agricultural use of the DW project

islands and would substantially change wildlife habitats on the DW project islands compared with habitats under existing conditions. In general, the impacts would result primarily from conversion of fallow, herbaceous upland, riparian, and wetland habitats to crops (Table 3H-11) (see Chapter 3G, "Vegetation and Wetlands").

Implementation of the No-Project Alternative would result in conversion of large acreages of corn and wheat crops to potatoes, onions, asparagus, and vineyards on Bacon and Bouldin Islands. Substantial acreages of fallow, exotic marsh (i.e., agricultural weeds growing in saturated soils), and pasture habitat on Holland and Webb Tracts would be converted to corn and wheat. Efficiency of harvest for corn and other seed crops would increase; thus, amounts of waste corn per acre left on Holland and Webb Tracts would be expected to decline to the levels measured on Bouldin Island (105 pounds per acre).

Continued agricultural operation would increase subsidence and risk of future flooding (see Chapter 3D, "Flood Control", for more details on subsidence and flooding). Abandonment of operations following flooding would reduce habitat values for most wildlife species.

Use by General Wildlife Species

Conversion of fallow, wetland, herbaceous upland, and riparian habitats on the four DW project islands under the No-Project Alternative would reduce the abundance of many wildlife species that rely on these habitats. The increase in acreages of crops would increase wintering habitat for those species that prefer areas that are bare or that support low vegetation. Abundance of prey species and foraging habitats for raptors would decrease, causing a reduction in use of the islands by wintering raptors. Although the total acreage of corn would decline, the amount of corn that would be managed under an intensive regime would increase from 3,200 acres to 4,200 acres (see Chapter 3G, "Vegetation and Wetlands"). The resulting increase in the acreage flooded for weed control would provide additional habitat for wading birds, shorebirds, and other waterbirds.

Riparian woodland considered jurisdictional wetlands under Section 404 and scrub habitat and marshes that are currently present on the DW project islands would be lost under the No-Project Alternative.

Use by Waterfowl

Overall habitat values for wintering waterfowl under the No-Project Alternative would be similar to or slightly higher than those found under existing conditions. Habitat values would increase despite a decrease in the acreage of corn and the abundance of waste corn left in fields because both the acreage of cornfields flooded for weed control and the total crop acreage would increase.

Use by Upland Game

Habitat values for ring-necked pheasant and desert cottontail would decrease with conversion of fallow fields to crops. Riparian habitats used by mourning dove and quail would also decrease under the No-Project Alternative.

Use by Special-Status Species

Most special-status species that occur or that could occur on the DW project islands would not be affected by implementation of the No-Project Alternative.

Northern harrier nesting habitat on Holland and Webb Tracts would be lost with conversion of fallow lands to crops. Loss of potential Swainson's hawk foraging habitat would also be expected. The reduction in the acreage of corn on Bouldin Island would reduce the amount of potential foraging habitat for greater sandhill cranes that use the island; however, increases of corn on other islands may offset this potential impact.

Summary of Project Impacts and Recommended Mitigation Measures

Loss of Riparian and Wetland Habitats. Up to 136 acres of riparian woodland and scrub habitats and 1,417 acres of wetland habitats could be lost under the No-Project Alternative (Table 3H-11). Impacts on wildlife resulting from the loss of riparian and wetland habitats under the No-Project Alternative would be substantial. Implementing the following measure would reduce this effect of the No-Project Alternative.

Develop and Implement an Offsite Wildlife Habitat Mitigation Plan. DW should develop and implement an offsite mitigation plan that would mitigate impacts on wildlife habitat.

Loss of Northern Harrier Nesting Habitat. A total of 2,400 acres of potential northern harrier nesting habitat would be lost under the No-Project Alternative. Implementing the following measure would reduce this effect of the No-Project Alternative.

Develop and Implement an Offsite Wildlife Habitat Mitigation Plan. This measure is described above.

Loss of Potential Swainson's Hawk Foraging Habitat. Approximately 2,400 acres of suitable Swainson's hawk foraging habitat would be lost under the No-Project Alternative. Implementing the following measure would reduce this effect of the No-Project Alternative.

Develop and Implement an Offsite Wildlife Habitat Mitigation Plan. This measure is described above.

CUMULATIVE IMPACTS

Cumulative impacts are the result of the incremental impacts of the proposed action when added to other past, present, and reasonably foreseeable future actions. This section briefly analyzes cumulative impacts for major wildlife issues. The analysis identifies other projects or activities in the Delta region and surrounding areas that may affect those wildlife species and habitats that may also be affected by the DW project. These projects are summarized in Appendix 2, "Supplemental Description of the Delta Wetlands Project Alternatives". Beneficial and negative cumulative effects are identified, and the overall effect of DW project impacts on regional wildlife habitats is described.

Cumulative Impacts, Including Impacts of Alternative 1

Changes in Reservoir Island Storage Conditions

DWR recently installed four additional pumping units at SWP's Banks Pumping Plant near Clifton Court Forebay, increasing total SWP pumping capacity from 6,400 cfs to 10,300 cfs. If SWP export pumping is increased to full capacity in future years, the frequency with which each storage class would occur on the DW project islands would change. Tables 3H-2 and 3H-3 present the storage class frequencies for the reservoir islands under this cumulative scenario for Alternative 1 based on the 70-year hydrologic record for the Delta. In most months the frequency with which full-, partial-, and shallow-storage conditions would occur would be reduced and the occurrence of nonstorage conditions and the opportunity to create shallow-water wetland conditions would be increased.

Foraging Habitat for Wintering Waterfowl

Several other projects proposed for the Delta region may adversely affect waterfowl foraging habitat in the Delta. Under implementation of the preferred alternative for the Interim South Delta Water Management Program, Clifton Court Forebay would be expanded to encompass existing agricultural land used by waterfowl (DWR 1994). Compensation for impacts of this and other DWR projects, however, has been incorporated into management of Twitchell Island and Sherman Island as habitat islands (DWR 1994). DWR proposals to remove other west Delta islands from row crop agriculture (to prevent subsidence and potential levee failure) would also reduce the availability of waste grain for waterfowl forage (DWR 1988). Compensation for those proposals could also be incorporated into management of Twitchell and Sherman Islands as habitat islands to prevent overall loss of Delta habitat value.

Several other projects could maintain or increase foraging habitat value for wintering waterfowl in the Delta. Levee rehabilitation conducted under the Delta Flood Protection Act (DWR 1990b) would help maintain agricultural production and waste grain availability on protected islands. The Central Valley Habitat Joint Venture (CVHJV), a coalition of state and federal conservation agencies and private organizations, has proposed to augment waterfowl food availability in the Delta by paying farmers to leave land untilled and shallowly flooded for waterfowl. This program could substantially increase waterfowl food availability in the Delta.

The overall effect of proposed projects in the Delta (including implementation of Alternative 1) would be beneficial for wintering waterfowl foraging habitat if identified negative impacts of the projects can be offset through implementation of beneficial projects (e.g., Twitchell and Sherman Island habitat restoration and the DW HMP) that enhance habitat values.

Impact H-38: Cumulative Increase in Foraging Habitat for Wintering Waterfowl in the Delta. Foraging habitat for wintering waterfowl would increase in the Delta as mitigation projects that convert existing land uses to habitat uses (including the DW project) are implemented. This is considered a beneficial cumulative impact.

Mitigation. No mitigation is required.

Herbaceous Habitats

Other projects proposed for the Delta region could alter amounts of herbaceous habitats in the Delta and affect dependent wildlife species. Species of particular importance that use these habitats include Swainson's hawk, northern harrier, and greater sandhill crane. These projects would also affect general wildlife species that use this habitat type.

Water management and flood control projects could reduce amounts of herbaceous habitats in the Delta region, but other projects, including habitat restoration and subsidence control projects, may offset many of those reductions. The South Delta Water Management Program would flood some herbaceous habitats. Compensation for impacts of this project, however, has been incorporated into the Sherman Island Wildlife Management Plan and would result in a net increase in herbaceous habitat acreage. Delta levee rehabilitation projects would temporarily remove herbaceous habitats, but most of these areas are narrow and linear and are not used extensively by special-status species. DWR's proposed program to reduce subsidence by retiring west Delta islands from intensive agriculture would substantially increase amounts of herbaceous habitats in the Delta.

The future amounts of herbaceous habitats in the Delta depend on the extent to which these programs are implemented. The DW project would substantially reduce wildlife habitat values on a small proportion of the acreage of fallow and other herbaceous habitats in the Delta by periodically flooding two islands. This loss would significantly contribute to regional changes in herbaceous habitats. It appears likely that total amounts of herbaceous habitats in the Delta could cumulatively increase as habitat restoration projects are implemented and agricultural lands are retired for subsidence control.

Impact H-39: Cumulative Loss of Herbaceous Habitats in the Delta. Delta levee rehabilitation, water management, and flood control projects could reduce amounts of herbaceous habitat in the Delta region. This cumulative effect may be offset by habitat restoration and subsidence control projects that are separately or jointly implemented with those projects. The DW project would contribute to the loss of herbaceous habitats by flooding the reservoir islands but would compensate for the project's direct losses by creating habitats on the habitat islands. Because it is likely that any cumulative losses of herbaceous habitats in the Delta would be offset by habitat restoration projects, this impact is considered less than significant.

Mitigation. No mitigation is required.

Riparian Habitat

The temporary loss of riparian habitat on the DW project islands could coincide with flood control projects that would disturb riparian vegetation on levees in the Delta. Development of riparian habitat for the DW project on habitat islands and mitigation for other projects would prevent long-term cumulative impacts. Enhancement and creation of riparian habitat are being considered at Prospect Island by the Corps, at Sherman Island by DWR and DFG, and at Franks Tract by California Department of Parks and Recreation (DPR).

Impact H-40: Cumulative Temporary Loss of Riparian Habitat in the Delta. As described for herbaceous habitat in Impact H-39, Delta levee rehabilitation, water management, and flood control projects could reduce amounts of riparian habitat in the Delta region. Losses of riparian vegetation during levee improvement projects is commonly temporary, and any long-term losses would be offset by habitat restoration and subsidence control projects that are separately or jointly implemented with those projects. Therefore, this impact is considered less than significant.

Mitigation. No mitigation is required.

Cumulative Impacts, Including Impacts of Alternative 2

The cumulative impacts of Alternative 2 are the same as those listed above for Alternative 1.

Cumulative Impacts, Including Impacts of Alternative 3

Other projects and activities in the Delta and surrounding regions that may have impacts on wildlife that are similar to those of Alternative 3 are the same as those described in the previous section for Alternative 1.

Changes in Reservoir Island Storage Conditions

Future changes in the frequency of storage condition classes under this alternative are similar to those described for Alternative 1; partial-storage conditions would occur more frequently in some months (see Appendix G4, "Simulated End-of-Month Water Storage on Reservoir Islands for the Delta Wetlands Project Alternatives").

Foraging Habitat for Wintering Waterfowl

The loss of late-winter foraging habitat value for wintering waterfowl on the DW project islands under Alternative 3 would be substantial compared with losses associated with other foreseeable projects in the Delta. As discussed previously, the food losses on the DW islands represent a small but important proportion of the total food available to waterfowl in the Delta. The implementation of offsite mitigation, however, could offset losses resulting from implementation of Alternative 3.

Impact H-41: Cumulative Loss of Foraging Habitat for Wintering Waterfowl in the Delta. Implementation of water management and flood control projects (including implementation of Alternative 3) could reduce the amounts of foraging habitat for wintering waterfowl in the Delta region. However, implementing habitat restoration, subsidence control, and habitat compensation projects proposed as part of those projects or as a separate project would offset this loss. Therefore, this impact is considered less than significant.

Mitigation. No mitigation is required.

Herbaceous Habitats

The contribution of Alternative 3 to the cumulative impact on herbaceous habitats would be the same as described for Alternative 1.

Impact H-42: Cumulative Loss of Herbaceous Habitats in the Delta. This impact is described above under Impact H-39. This impact is considered less than significant.

Mitigation. No mitigation is required.

Emergent Wetland and Riparian Habitats

Water management and flood control projects could reduce the amounts of emergent wetland and riparian habitats in the Delta region. Alternative 3 would contribute to this impact by reducing emergent wetland and riparian habitats by approximately 72 acres on the DW project islands, but implementation of recommended offsite mitigation could fully compensate for this loss. The creation of a large acreage of seasonal wetland available some years on the DW islands would also benefit some species that prefer dense emergent wetlands. As described above for herbaceous and riparian habitats, cumulative losses of emergent wetland and riparian habitats would be offset by habitat restoration and subsidence control projects proposed for the Delta.

Impact H-43: Cumulative Loss of Wetland and Riparian Habitats in the Delta. Implementation of water management and flood control projects (including implementation of Alternative 3) could reduce the amount of emergent wetland and riparian habitats in the Delta region. However, implementing habitat restoration, subsidence control, and habitat compensation projects proposed as part of those projects or as a separate project would offset this loss. Therefore, this impact is considered less than significant.

Mitigation. No mitigation is required.

Cumulative Impacts, Including Impacts of the No-Project Alternative

The No-Project Alternative would not have a significant cumulative impact on wildlife populations or habitats in the Delta. Continued and more intensive cultivation of the DW project islands, however, would increase the rate of island subsidence and increase the likelihood for levee failure (see Chapter 3D, "Flood Control"). Levee failure would result in substantial loss of terrestrial wildlife habitats in the Delta.

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Table 3H-1. Characteristics of Evaluation Species Analyzed in the DW HEP Analysis

Species	Wildlife Guilds Represented	General Habitats Used[a]			HEP Analysis Periods (dates)
		Agricultural	Wetland	Herbaceous	
Tundra swan	Waterfowl	XX	XX	--	10/16-4/15
White-fronted goose	Geese	XX	XX	X	10/16-4/15
Northern pintail	Dabbling ducks	XX	XX	--	9/1-4/15
Canvasback	Diving ducks	X	XX	--	10/16-4/15
Ring-necked pheasant	Upland game	XX	--	XX	All year
American kestrel	Raptors	X	--	XX	All year
Black-bellied plover	Shorebirds	X	XX	X	7/15-5/31
Western meadowlark	Resident songbirds	X	--	XX	All year
White-crowned sparrow	Wintering songbirds	X	--	XX	9/1-5/31
California vole	Small mammals	X	--	XX	All year

Note: -- = not applicable.

[a] XX = major use.
X = minor use.

Table 3H-2. Frequency of Habitat Condition Classes on Bacon Island under Alternative 1 and Cumulative Conditions for Alternative 1 (Percentage of Years)

Month	Alternative 1					Cumulative Alternative 1				
	Full Storage	Partial Storage	Shallow Storage	Nonstorage	Shallow-Water Wetland	Full Storage	Partial Storage	Shallow Storage	Nonstorage	Shallow-Water Wetland
May	65.7	13.0	0.0	21.4	0.0	58.6	4.3	0.0	32.9	0.0
June	61.4	15.9	1.4	21.4	0.0	52.9	14.3	0.0	32.9	0.0
July	34.3	21.4	10.0	34.3	0.0	1.4	1.4	0.0	97.1	0.0
August	10.0	5.7	4.3	80.0	0.0	1.4	0.0	0.0	98.6	0.0
September	11.4	1.4	1.4	57.1	28.6	4.3	1.4	2.9	0.0	91.4
October	28.6	2.9	0.0	20.0	48.6	14.3	5.7	0.0	1.4	78.6
November	45.7	1.4	1.4	1.4	50.0	30.0	5.7	0.0	2.9	61.4
December	51.4	7.1	2.9	2.9	35.7	40.0	5.7	0.0	7.1	47.1
January	67.1	5.7	1.4	4.3	21.4	57.1	5.7	0.0	2.9	34.3
February	74.3	5.7	4.3	1.4	14.3	64.3	8.6	2.9	1.4	22.9
March	75.7	7.1	4.3	4.3	8.6	67.1	8.6	2.9	1.4	20.0
April	74.3	2.9	5.7	8.6	8.6	65.7	4.3	7.1	2.9	20.0

Notes: Percentages may not total to 100.0 because of rounding.

Frequencies were estimated based on the 70-year hydrologic record for the Delta. The frequency with which each flood condition class would occur in future years, however, is unpredictable. Frequencies do not include periods when reservoir islands may be used for water transfers or banking. If reservoir islands are used to transfer or bank water, the frequency of storage periods could be expected to increase and the frequency of nonstorage and shallow-water wetland periods could be expected to decrease.

Table 3H-3. Frequency of Habitat Condition Classes on Webb Tract under Alternative 1 and Cumulative Conditions for Alternative 1 (Percentage of Years)

Month	Alternative 1					Cumulative Alternative 1				
	Full Storage	Partial Storage	Shallow Storage	Nonstorage	Shallow-Water Wetland	Full Storage	Partial Storage	Shallow Storage	Nonstorage	Shallow-Water Wetland
May	67.1	11.6	0.0	21.4	0.0	58.6	8.6	0.0	32.9	0.0
June	62.9	14.5	1.4	21.4	0.0	55.7	11.4	0.0	32.9	0.0
July	37.1	18.6	10.0	34.3	0.0	1.4	1.4	0.0	97.1	0.0
August	10.0	7.1	7.1	75.7	0.0	1.4	0.0	0.0	98.6	0.0
September	11.4	1.4	1.4	57.1	28.6	4.3	1.4	2.9	0.0	91.4
October	28.6	2.9	0.0	20.0	48.6	14.3	5.7	0.0	1.4	78.6
November	45.7	1.4	1.4	1.4	50.0	31.4	4.3	0.0	2.9	61.4
December	51.4	7.1	2.9	2.9	35.7	40.0	5.7	0.0	7.1	47.1
January	68.6	4.3	1.4	4.3	21.4	57.1	5.7	0.0	2.9	34.3
February	75.7	4.3	4.3	1.4	14.3	64.3	8.6	2.9	1.4	22.9
March	75.7	7.1	4.3	4.3	8.6	67.1	8.6	2.9	1.4	20.0
April	74.3	5.7	5.7	8.6	8.6	65.7	4.3	5.7	4.3	20.0

Notes: Percentages may not total 100.0 because of rounding.

Frequencies were estimated based on the 70-year hydrologic record for the Delta. The frequency with which each flood condition class would occur in future years, however, is unpredictable. Frequencies do not include periods when reservoir islands may be used for water transfers or banking. If reservoir islands are used to transfer or bank water, the frequency of storage periods could be expected to increase and the frequency of nonstorage and shallow-water wetland periods could be expected to decrease.

Table 3H-4. Acreages of Habitats to Be Developed on the DW Habitat Islands under Alternative 1

Habitat Type[a]	Bouldin Island		Holland Tract		Habitat Island Totals	
	Total Acres	Percentage of Total Acres	Total Acres	Percentage of Total Acres	Total Acres	Percentage of Total Acres
Corn/wheat	1,629	27	955	31	2,584	29
Small grains	106	2	152	5	258	3
Mixed agriculture/seasonal wetland	1,014	17	631	21	1,645	18
Seasonal managed wetland	1,723	29	393	13	2,116	23
Seasonal pond	66	1	68	2	134	1
Pasture/hay	132	2	72	2	204	2
Emergent marsh[b]	208	3	194	6	402	4
Riparian[b]	170	3	217	7	387	4
Lake[b]	111	2	33	1	144	2
Herbaceous upland[b]	479	8	253	8	732	8
Developed	177	3	58	2	235	3
Canal[b]	70	1	10	0	80	1
Borrow pond	89	1	0	0	89	1
Total	5,974	100	3,036	100	9,010	100

Note: Minor inconsistencies in totals are the result of rounding.

[a] Habitat types and habitat management prescriptions are described in Appendix G3, "Habitat Management Plan for the Delta Wetlands Habitat Islands".

[b] Includes existing acres of habitat unaffected by the DW project.

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Table 3H-5. Habitat Island Habitats Used by General Wildlife Species

Species Group	Representative Species	Foraging Habitats	Breeding Habitats
Raptors	Red-tailed hawk American kestrel Great horned owl	■ Unflooded corn and wheat ■ Small grains ■ Unflooded mixed agriculture/seasonal wetland ■ Unflooded seasonal managed wetland ■ Pasture/hay ■ Herbaceous upland ■ Riparian woodland ■ Riparian scrub	■ Riparian woodland ■ Riparian scrub
Grassland and agricultural birds	Ring-necked pheasant Western meadowlark	■ Unflooded corn and wheat ■ Small grains ■ Unflooded mixed agriculture/seasonal wetland ■ Unflooded seasonal managed wetland ■ Pasture/hay ■ Herbaceous upland	■ Small grains ■ Unflooded mixed agriculture/seasonal wetland ■ Unflooded seasonal managed wetland ■ Pasture/hay ■ Herbaceous upland
Small mammals	California vole Deer mouse	■ Unflooded corn and wheat ■ Small grains ■ Unflooded mixed agriculture/seasonal wetland ■ Unflooded seasonal managed wetland ■ Pasture/hay ■ Herbaceous upland ■ Riparian woodland ■ Riparian scrub ■ Developed	■ Unflooded corn and wheat ■ Small grains ■ Unflooded mixed agriculture/seasonal wetland ■ Unflooded seasonal managed wetland ■ Pasture/hay ■ Herbaceous upland ■ Riparian woodland ■ Riparian scrub ■ Developed
Furbearers	Raccoon Striped skunk	■ Corn and wheat ■ Small grains ■ Mixed agriculture/seasonal wetland ■ Seasonal managed wetland ■ Pasture/hay ■ Emergent marsh ■ Permanent lake shoreline ■ Herbaceous upland ■ Riparian woodland ■ Riparian scrub ■ Canals ■ Developed	■ Riparian woodland ■ Riparian scrub ■ Developed
Migrating and wintering shorebirds	Western sandpiper Dowitcher Long-billed curlew Dunlin	■ Shallow-flooded corn and wheat ■ Shallow-flooded mixed agriculture/seasonal wetland ■ Shallow-flooded seasonal managed wetland ■ Seasonal pond ■ Shallow-flooded and dry pasture/hay ■ Shallow-flooded emergent marsh ■ Permanent lake shoreline	Not applicable

Table 3H-5. Continued

Species Group	Representative Species	Foraging Habitats	Breeding Habitats
Breeding shorebirds	American avocet Black-necked stilt	■ Shallow-flooded corn and wheat ■ Shallow-flooded seasonal managed wetland ■ Seasonal pond ■ Shallow-flooded emergent marsh ■ Permanent lake shoreline	■ Shallow-flooded seasonal wetland ■ Seasonal pond ■ Emergent marsh
Cavity-nesting birds	Nuttall's woodpecker House wren	■ Riparian woodland ■ Riparian scrub	■ Riparian woodland ■ Riparian scrub
Wading birds	Great blue heron Great egret Black-crowned night heron	■ Corn and wheat ■ Small grains ■ Mixed agriculture/seasonal wetland ■ Seasonal managed wetland ■ Seasonal pond ■ Pasture/hay ■ Emergent marsh ■ Permanent lake shoreline ■ Herbaceous upland	■ Seasonal managed wetland ■ Emergent marsh ■ Riparian woodland ■ Riparian scrub
Migratory and resident songbirds	White-crowned sparrow Yellow warbler Yellow-rumped warbler Savannah sparrow Plain titmouse Bushtit	■ Small grains ■ Unflooded mixed agriculture/seasonal wetland ■ Unflooded seasonal managed wetland ■ Pasture/hay ■ Herbaceous upland ■ Riparian woodland ■ Riparian scrub	■ Small grains ■ Unflooded mixed agriculture/seasonal wetland ■ Unflooded seasonal managed wetland ■ Pasture/hay ■ Herbaceous upland ■ Riparian woodland ■ Riparian scrub
Wetland songbirds	Marsh wren Red-winged blackbird Yellow-headed blackbird	■ Mixed agriculture/seasonal wetland ■ Seasonal managed wetland ■ Seasonal pond ■ Pasture/hay ■ Emergent marsh ■ Herbaceous upland ■ Canals	■ Seasonal managed wetland ■ Seasonal pond ■ Emergent marsh ■ Canals

Table 3H-6. Delta Special-Status Wildlife Species That Occur or Could Occur on the DW Habitat Islands

Species	Legal Status: Federal/State[a]	Preferred Habitats	Occurrence in the Delta[b]	Foraging or Roosting Habitats	Breeding Habitats[c]
Valley elderberry longhorn beetle	T/--	Elderberry shrubs in riparian habitats	R	■ Elderberry shrubs planted in riparian scrub and riparian woodland habitats	■ Elderberry shrubs planted in riparian scrub and riparian woodland habitats
Western pond turtle	C2/SSC	Marshes, streams, and ponds	R	■ Seasonal pond ■ Emergent marsh ■ Permanent lake ■ Canal ■ Borrow pond	■ Herbaceous upland
Giant garter snake	T/T	Marshes, streams, and ponds	R	■ Seasonal managed wetland ■ Seasonal pond ■ Emergent marsh ■ Permanent lake ■ Canal ■ Borrow pond	■ Herbaceous upland
American white pelican	--/SSC	Marshes and open water	W	■ Seasonal managed wetland ■ Seasonal pond ■ Emergent marsh ■ Permanent lake ■ Borrow pond	N/A
Double-crested cormorant	--/SSC	Open water for foraging and roosting; valley oaks and cottonwood forests for nesting	NR	■ Emergent marsh ■ Permanent lake ■ Borrow pond	N/A
White-faced ibis	C2/SSC	Freshwater marshes (rookery sites)	NR	■ Mixed agriculture/seasonal wetland ■ Seasonal managed wetland ■ Seasonal pond ■ Pasture/hay ■ Emergent marsh ■ Herbaceous upland	■ Emergent marsh ■ Seasonal pond
Aleutian Canada goose	T/--	Wetland and agricultural habitats	W	■ Corn and wheat fields ■ Small grain ■ Mixed agriculture/seasonal wetland ■ Seasonal managed wetland ■ Seasonal pond ■ Pasture/hay ■ Emergent marsh ■ Permanent lake ■ Herbaceous upland	N/A

Species	Legal Status: Federal/State[a]	Preferred Habitats	Occurrence in the Delta[b]	Foraging or Roosting Habitats	Breeding Habitats[c]
Black-shouldered kite	--/FP	Riparian habitats for nesting; wetlands and grasslands for foraging	R	■ Mixed agriculture/seasonal wetland ■ Seasonal managed wetland ■ Seasonal pond ■ Pasture/hay ■ Riparian woodland ■ Riparian scrub ■ Herbaceous upland	■ Riparian woodland ■ Riparian scrub
Bald eagle	E/E	Streams and lakes	W	■ Mixed agriculture/seasonal wetland ■ Seasonal managed wetland ■ Seasonal pond ■ Emergent marsh ■ Riparian woodland ■ Riparian scrub ■ Permanent lake	N/A
Northern harrier	--/SSC	Marshes and meadows and seasonal and agricultural wetlands	R	■ Corn and wheat fields ■ Small grain ■ Mixed agriculture/seasonal wetland ■ Seasonal managed wetland ■ Seasonal pond ■ Pasture/hay ■ Emergent marsh ■ Permanent lake ■ Herbaceous upland	■ Small grain ■ Seasonal managed wetland ■ Pasture/hay ■ Emergent marsh ■ Herbaceous upland
Sharp-shinned hawk	--/SSC	Riparian habitats	W	■ Riparian woodland ■ Riparian scrub	N/A
Cooper's hawk	--/SSC	Riparian habitats and oak woodlands for nesting	R	■ Riparian woodland ■ Riparian scrub	■ Riparian woodland ■ Riparian scrub
Swainson's hawk	--/T	Agricultural habitats for foraging and riparian habitats for nesting	W	■ Corn and wheat fields ■ Small grain fields ■ Mixed agriculture/seasonal wetland ■ Seasonal managed wetland ■ Pasture/hay ■ Herbaceous upland	■ Riparian woodland ■ Riparian scrub

Species	Legal Status: Federal/State[a]	Preferred Habitats	Occurrence in the Delta[b]	Foraging or Roosting Habitats	Breeding Habitats[c]
Peregrine falcon	E/E	Marshes and seasonal and agricultural wetlands	W	■ Corn and wheat fields ■ Mixed agriculture/seasonal wetland ■ Seasonal managed wetland ■ Seasonal pond ■ Pasture/hay ■ Emergent marsh ■ Permanent lake ■ Herbaceous upland	N/A
Prairie falcon	--/SSC	Uplands, marshes, and seasonal and agricultural wetlands	W	■ Corn and wheat fields ■ Mixed agriculture/seasonal wetland ■ Seasonal managed wetland ■ Seasonal pond ■ Pasture/hay ■ Emergent marsh ■ Permanent lake ■ Herbaceous upland	N/A
Greater sandhill crane	--/T	Forages in agricultural habitats and roosts in shallow wetlands	W	■ Corn and wheat fields ■ Small grain ■ Mixed agriculture/seasonal wetland ■ Seasonal managed wetland ■ Seasonal pond ■ Pasture/hay ■ Herbaceous upland	N/A
California gull	--/SSC	Widespread in winter	NR	■ Corn and wheat fields ■ Mixed agriculture/seasonal wetland ■ Seasonal managed wetland ■ Seasonal pond ■ Pasture/hay ■ Emergent marsh ■ Permanent lake ■ Herbaceous upland ■ Borrow pond	N/A
Yellow-billed cuckoo	--/E	Deciduous riparian forests	R	■ Riparian woodland ■ Riparian scrub	■ Riparian woodland

Species	Legal Status: Federal/State[a]	Preferred Habitats	Occurrence in the Delta[b]	Foraging or Roosting Habitats	Breeding Habitats[c]
Short-eared owl	--/SSC	Marshes and seasonal and agricultural wetlands	R	■ Corn and wheat fields ■ Small grain ■ Mixed agriculture/seasonal wetland ■ Seasonal managed wetland ■ Seasonal pond ■ Pasture/hay ■ Emergent marsh ■ Herbaceous upland	■ Small grain ■ Mixed agriculture/seasonal wetland ■ Seasonal managed wetland ■ Seasonal pond ■ Pasture/hay ■ Emergent marsh ■ Herbaceous upland
Long-eared owl	--/SSC	Roosts in riparian habitats; feeds in wetlands, grasslands, and agricultural habitats	W	■ Corn and wheat fields ■ Small grain ■ Mixed agriculture/seasonal wetland ■ Seasonal managed wetland ■ Seasonal pond ■ Pasture/hay ■ Riparian woodland ■ Riparian scrub ■ Herbaceous upland	N/A
Burrowing owl	--/SSC	Forages in open grassland and agricultural habitats; ground burrows in sparse grassland for nesting	R	■ Corn and wheat fields ■ Small grain ■ Pasture/hay ■ Herbaceous upland	■ Herbaceous upland
Willow flycatcher	--/SSC	Riparian habitats	M	■ Riparian woodland ■ Riparian scrub	N/A
Yellow warbler	--/SSC	Riparian habitats	M	■ Riparian woodland ■ Riparian scrub	N/A
Tricolored blackbird	C2/SSC	Nonwoody riparian habitats, weedy vegetation, and marshes for breeding; marshes and agricultural wetlands for feeding	R	■ Mixed agriculture/seasonal wetland ■ Seasonal managed wetland ■ Seasonal pond ■ Pasture/hay ■ Emergent marsh ■ Permanent lake	■ Seasonal managed wetland ■ Seasonal pond ■ Emergent marsh ■ Permanent lake

[a] Status definitions:

Federal

E = listed as endangered under the federal Endangered Species Act.

T = listed as threatened under the federal Endangered Species Act.

C2 = Category 2 candidate for federal listing. Category 2 includes species for which USFWS has some biological information indicating that listing may be appropriate but for which further biological research and field study are usually needed to clarify the most appropriate status. Category 2 species are not necessarily less rare, threatened, or endangered than Category 1 species or listed species; the distinction relates to the amount of data available and is therefore administrative, not biological.

-- = no listing status.

State

E = listed as endangered under the California Endangered Species Act.

FP = fully protected under California Fish and Game Code.

T = listed as threatened under the California Endangered Species Act.

SSC = DFG species of special concern.

-- = no listing status.

[b] W = wintering species.
NR = nonbreeding resident.
M = migrant.
R = resident.

[c] N/A = not applicable.

Table 3H-7. Changes in Habitat Acreages from Existing Conditions to Conditions under Alternative 1

Habitat Type[a]	Existing		Alternative 1		Change from Existing to Alternative 1 Conditions[b]	
	Reservoir Islands (acres)	Habitat Islands (acres)	Reservoir Islands (acres)	Habitat Islands (acres)	Acres	Percentage
Riparian woodland and scrub (same)	109	122	0.0	387	+156	+67.5
Freshwater marsh (emergent marsh)	175	49	0.0[c]	402	+178	+79.9
Exotic marsh (mixed agriculture/seasonal wetland, seasonal managed wetland, and seasonal pond)	814	310	0.0[c]	3,895	+2,771	+246.5
Herbaceous upland (same)	1,367	982	0.0[c]	732	-1,617	-68.8
Corn, wheat, and milo (corn rotated with wheat, and small grains)	3,527	4,193	0.0	2,842	-4,878	-63.2
Pasture (pasture/hay)	61	384	0.0	204	-241	-54.2
Other crops and fallow fields (none)	4,600	2,775	0.0	0	-7,375	-100.0
Sloughs and ditches (canal)	142	158	0.0	80	-220	-73.3
Pond - all year (borrow areas and permanent lake)	107	17	0.0[c]	233	+109	+88.2
Total or average	10,902	8,990	0.0[c]	8,775	-11,117	-55.9

[a] Habitats in parentheses are equivalent habitats to be developed on the habitat islands.

[b] See "Summary of Project Impacts and Recommended Mitigation Measures" for Alternative 1 for a description of how habitat losses would be mitigated.

[c] These habitats would exist on the reservoir islands during some operating years; however, because the areal extent of these habitat types and the frequency with which they would appear are unpredictable, no habitat acreage is credited.

Table 3H-8. Estimated Annual Waterfowl Harvest under Existing Use and Alternative 1

Island	Existing Use			Alternative 1		
	Number of Hunter Use-Days	Number of Birds Harvested[a]		Maximum Number of Hunter Use-Days[b]	Number of Birds Harvested[c]	
		Geese	Ducks		Geese	Ducks
Bacon	0	0	0	2,592	259	3,888
Webb	320	50	350	2,664	266	3,996
Bouldin	150	15	175	7,424	742	11,136
Holland	60	5	25	3,449	345	5,174
Total	530	70	550	16,129	1,612	24,194

[a] See Table H2-12 in Appendix H2, "Wildlife Inventory Methods and Results", for sources of current harvest rates.

[b] See Chapter 3J, "Recreation and Visual Resources", for methods used in calculating estimated numbers of annual hunter use-days.

[c] Average harvest rates are assumed to be 1.5 ducks/hunter/day and 0.1 goose/hunter/day, respectively, under the proposed project.

Table 3H-9. Comparison of Impacts of Alternatives 1, 2, and 3 on Acreages of Suitable Foraging Habitat for Swainson's Hawk, Wintering Raptors, Greater Sandhill Crane, and Wintering Waterfowl

	Increase (+) or Decrease (-) in Foraging Habitat Acres from Existing Conditions								
	Swainson's Hawk and Wintering Raptors			Greater Sandhill Crane			Wintering Waterfowl		
Habitat Type	Alts. 1 and 2[a]	Alt. 3[b]	Additional Acreage Affected under Alt. 3	Alts. 1 and 2[a]	Alt. 3[b]	Additional Acreage Affected under Alt. 3	Alts. 1 and 2[a]	Alt. 3[b]	Additional Acreage Affected under Alt. 3
Exotic marsh	+2,771	-858	858	+2,771	-858	858	+2,771	-858	858
Herbaceous upland	-1,617	-2,251	634	-1,617	-2,251	634	-1,617	-2,251	634
Agriculture	-10,660	-14,420	3,760	-7,406	-11,111	3,705	-12,216	-15,975	3,759
Freshwater marsh	N/A	N/A	N/A	N/A	N/A	N/A	+179	-224	224
Permanent pond	N/A	N/A	N/A	N/A	N/A	N/A	+20	-80	80
Total	-9,508.9	-17,529	5,252	-6,252	-14,220	5,197	-10,863	-19,388	5,555

Note: N/A = not applicable.

[a] See Impacts H-1, H-3, H-6, and H-8 and Appendix G3, "Habitat Management Plan for the Delta Wetlands Habitat Islands", for a description of how compensation for project impacts on wildlife associated with these habitats would be achieved (regarding habitat quality versus quantity).

[b] See Mitigation Measure H-4 for a description of how compensation for project impacts would be achieved.

Table 3H-10. Changes in Habitat Acreages from Existing Conditions to Conditions under Alternative 3

Habitat Type[a]	Existing Conditions on All Islands (acres)	Alternative 3		Change from Existing to Alternative 3 Conditions	
		Reservoir Islands (acres)	NBHA (acres)	Acres	Percentage
Riparian woodland and scrub (same)	248	0.0	200	-48	-19.4
Freshwater marsh (none)	224	0.0[b]	0.0	-224	-100.0
Exotic marsh (seasonal managed wetland)	1,188	0.0[b]	330	-858	-72.2
Herbaceous upland (same)	2,376	0.0[b]	125	-2,251	-94.7
Agriculture (corn and wheat)	16,424	0.0	170	-16,254	-99.0
Permanent ponds (perennial pond)	130	0.0[b]	50	-80	-61.5
Total or average	20,895	0.0[b]	875	-20,020	-95.8

[a] Habitats in parentheses are equivalent habitats that would be developed in the NBHA.

[b] These habitats would exist on the reservoir islands during some operating years; however, because the areal extent of these habitat types and the frequency with which they would appear are unpredictable, no habitat acreage is credited.

Table 3H-11. Predicted Changes in Acreages of Habitat Types under the No-Project Alternative

Habitat Type	Bacon Island		Webb Tract		Bouldin Island		Holland Tract		Total		
	1987 Acreage	No-Project Acreage	1987 Acreage	No-Project Acreage	1987 Acreage	No-Project Acreage	1987 Acreage	No-Project Acreage	1987 Acreage	No-Project Acreage	No-Project Acreage as Percentage of 1987 Acreage
Riparian woodland and scrub	3	3	106	56	17	7	122	46	248	112	45
Freshwater marsh	3	0	172	16	21	0	28	2	224	18	8
Exotic marsh	30	0	783	40	115	0	323	0	1,251	40	3
Woody non-native and herbaceous upland	528	261	839	220	354	349	569	113	2,290	943	41
Subtotal	564	264	1,900	332	507	356	1,042	161	4,013	1,113	28
Annual grain crops	3,091	3,126	2,695	4,961	4,530	3,329	1,118	3,083	11,434	14,499	127
Perennial crops orchards/vineyards	1,348	1,969	0	0	0	2,097	423	610	1,771	4,676	264
Pasture	0	0	61	0	34	0	571	256	666	256	38
Fallow	355	0	638	0	712	0	785	0	2,490	0	0
Subtotal	4,794	5,095	3,394	4,961	5,276	5,426	2,897	3,949	16,361	19,431	119
Sloughs and ditches	92	92	50	50	118	118	45	45	305	305	100
Ponds	3	3	106	106	9	9	23	23	141	141	100
Developed	86	86	20	20	75	75	243	71	424	252	59
Subtotal	181	181	176	176	202	202	311	139	870	698	80
Total	5,539	5,540	5,470	5,469	5,985	5,984	4,250	4,249	21,244	21,242	100

Note: Minor inconsistencies in totals result from rounding.

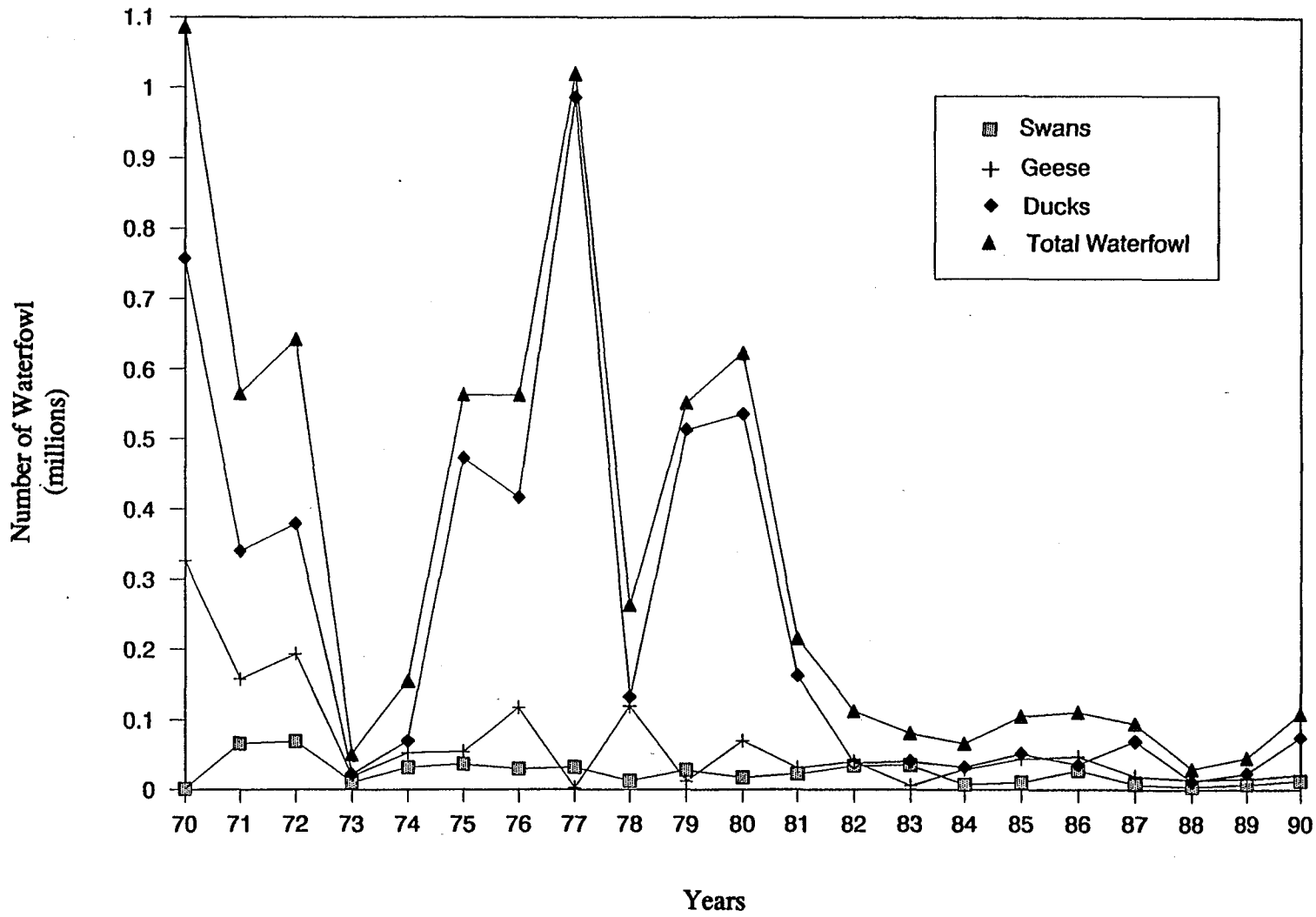

Figure 3H-1.
Waterfowl Populations Observed in the Annual Midwinter Delta Survey, 1970-1990